Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "THE ELECTRICAL ENGINEER."

VOL. XXXV. NEW YORK, SATURDAY, FEBRUARY 10, 1900. No. 6.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico . . . . . per year, $3.00
Foreign Countries within the Postal Union, ... 6.00
Single Copies, ...10
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(Entered as second-class mail matter at the New York Post Office.)

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THE COMING INSTITUTE ELECTION.

Considerably more interest than usual appears to be taken by the membership of the American Institute of Electrical Engineers in the coming election of a presiding officer, probably on account of the prominence of the position this year, in view of the joint meeting with the English Institution of Electrical Engineers, to be held during the summer at Paris. In our correspondence column will be found letters suggesting the names of two members as candidates, either of whom would most worthily represent the Institute in the presidential chair, both at home and abroad. A score or more of other names have been suggested in the same connection, and to illustrate the gratifying quantity of presidential timber the Institute possesses, we give the following list of those for whom claims have been advanced within our hearing during the past month: Abbott, Anthony, Arnold, Barstow, Bedell, Dr. Bell, Bradley, Carhart, Fessenden, Hering, Hewitt, Howell, Hutchinson, H. W. Leonard, J. W. Lieb, Lockwood, Mailloux, Nichols, Pickernell, Pupin, E. W. Rice, Ryan, Scott, Stanley, Steinmetz and Stillwell. In addition to their eminence in the profession represented by the Institute, a great proportion of those whose names figure in the list have taken a lively interest in the objects of the Institute. In view of the unfortunate experience of some years ago, in electing one who did not possess the latter qualification, and who never even acknowledged the notification of his election, care will doubtless continue to be exercised that the honor be not conferred upon one who has not taken a prominent part in the work of the Institute, however well qualified he may otherwise be for the office of president.

The length of the list given above—and to which many other names could appropriately be added—suggests the desirability of confining the presidential term to one year. The practice adopted some years ago of re-electing the incumbent of the presidential chair to a second term appears to be now fixed, for it has been realized that to make an exception to the custom might be construed as a reflection on the one-term president. The new constitution for the Institute, now in course of formulation by a committee of the Council, might well contain a clause forbidding re-election to the presidential chair—at least during a period of some years. It is true that a president is more proficient in his routine duties when serving a second term. On the other hand, the Council, composed as it is of members serving either two or three years in succession, possesses the experience and the necessary power to steer the Institute on its course so far as its government is concerned. As to qualifications for presiding officer, it is a remarkable illustration of the character of men who have been attracted to the engineering profession, that with probably not a single exception, all of those mentioned above are fitted to preside over the body with credit and dignity without a moment's apprenticeship.

ELECTRICITY IN THE NAVY.

Recently there have again cropped up in the newspapers sensational articles unfavorable to the use of electricity in the Navy. One of these reports that much trouble had been encountered with

the electrical machinery on the Kearsarge, and a naval officer is quoted as saying that while electricity is all right in some places, it cannot be depended upon to handle the turrets and large guns of a ship—that old and well-tried mechanisms should be adhered to instead of running great risks by introducing uncertain electrical apparatuses. An article in another paper states that work on the electric light and power plant in the New York Navy Yard has been suspended owing to the impracticability of the plans, with the result that there will be a delay of some months on this important work. The several accounts all bear the mark of having been inspired by people connected with the naval establishment, and the attacks convey the impression that they are the outcome of the bureaucratic jealousies of which electricity in the past has so often been a victim in the Navy. We are informed from an authoritative source that there is no foundation whatever for the reports in the case of the Kearsarge. There has been no difficulty at all in the working of the turrets, but, on the contrary, everything connected with the turret mechanism has functioned extremely well. Instead of electricity in the Navy being a failure, it is well known that in the opinion of those officers most competent to speak as to its applicability aboard ship, it will soon meet with wide extensions. In fact, in the opinion of these, the time is not far distant when electric motors will be employed to drive all auxiliaries on warships, steam being used only for the main engines and the central electric generating plant. As to the present, there would appear to exist an excellent opportunity for the Secretary of the Navy to exercise his disciplinary powers on those who unworthily seek to enhance their official importance by retarding desirable improvements in the efficiency of warships.

PROGRESSIVE SIBERIA.

People are beginning to expect great things from the Siberian railway which Russia has thrown across the vast extent of her Asian possessions, and it is certain that into those regions of immemorial barbarism the arts and benefits of civilization will now be swiftly carried. Much remains to be done, but it rather startling to be informed, as we are by Mr. L. W. Lodian in a recent article published by the *American Gas Light Journal,* that already in Central Siberia electric lighting enjoys vogue and ascendancy. According to this traveled authority, the vast majority of these Siberians have never seen gas, which is to them the illuminant of a past age. Almost all the towns have arcs for the streets and incandescents for interior lighting, and they handle the apparatus with such familiarity that Mr. Lodian never heard of a mishap. He suggests vaguely that immunity from accident may be due to the fact that they wear heavy rubber overshoes.

Just how this condition came about is not clearly explained, but Mr. Lodian seems to infer that it is due to an absence of coal and a greater plentitude of wood. According to him the only threatening rival to electricity is incandescent kerosene lamp lighting, but it would appear that the mantle problem is far from solved. In the meantime there is a suggestion for ambitious American exporters in the statement that the electrical apparatus used is brought from France, Germany and Belgium. A study of the Russian and Siberian field of opportunity by our consuls or by our commercial travelers would probably be well worth while.

MAGNETIC FIELD MEASURERS.

It is often very convenient to form definite ideas as to the density of stray magnetic fields in the neighborhood of dynamos, and an apparatus for that purpose is described elsewhere. It consists of a search-coil and a ballistic galvanometer. The former is not especially remarkable, having been used under substantially the same construction for the last ten years, but the latter is remarkable in the range of angular deflection obtained. Some indicating instruments are contented with 60° of angular range. Others, like the Weston instruments, take credit to themselves for displaying 90°. A few exult in 120° with conscious but pardonable pride. The instrument we are considering, however, boasts of no less than 800° or more than two complete twists, which is a very remarkable result, even though the deflection is but momentary. This contortion suggests a flexibility and elasticity of neck that is bewildering to contemplate, but it must add greatly to the indicating value of the instrument if accuracy has not been sacrificed on the altar of torsion.

HYSTERESIS IN IRON.

We print an interesting article by Dr. Sheldon upon some experiments with watch-charm compass magnets. It is shown that the hysteretic behavior of these magnets depends not only upon the distance between them in the direction of impressed magnetic force, but also upon the distance between them in the perpendicular direction. It would seem that if we regard the compass needles as soldiers arranged in parallel ranks all facing the impressed magnetic force, the hysteresis of the column will be greatest when the men have most elbow-room or side separation, and least foot-room or separation between the ranks, while for minimum hysteresis, the column should be lengthened and laterally compressed, giving increased distance between ranks, but least elbow-room. If this is correct, transformer plates should be pulled out powerfully in the direction of their length while being pressed heavily on their flat sides. This would also mean that æolotropic iron would be better suited to the purpose of the electrical engineer than isotropic iron. The experiments of Rhoades upon the hysteretic qualities of sheet iron seem to favor this view, while the results of ordinary annealing do not seem to favor it.

The results of experiments upon groups of magnet needles should only be applied to groups of molecular magnets with great circumspection, as the paper itself points out. We know so little, as yet, of the nature and effects of molecular dissymmetry in magnetisable materials that all deductions carried from the molar to the molecular structure are liable to error. The experiments themselves are, however, of great interest, and it is important to ascertain how far their results are borne out in the behavior of iron plates. It is not unreasonable to expect that great improvements may yet be made in the production of non-retentive iron, if only because so much improvement has already been effected in this direction during the last few years. It is possible to procure iron or steel sheets with a hysteretic constant much below the lowest values recognized six years ago. At the same time it is not easy to secure the best steel at present owing to the great demand for iron and steel and the pressure upon the rolling mills for supply. In the design, purchase, and operation of all classes of dynamo-electric machines, the reduction of the hysteretic coefficient is of great practical importance. Patents have been taken out for non-ageable iron or iron in which the hysteretic coefficient is constant; but no iron has yet been produced in which it has been made to disappear.

COMMUTATORLESS DIRECT-CURRENT DYNAMOS.

The commutatorless dynamo possesses a great fascination. It also boasts of a voluminous literature. Mighty and many have been the efforts made by experimental electricians during the last fifty years to generate unidirectional pressure without invoking the commutator's aid. The result has not been all failure. It seems that if the circuit does not make more than one turn around the generating magnetic field, the thing can be done, as Faraday demonstrated long

ago. In other words, a direct-current dynamo can be made with half an armature loop and no commutator, or with loops and a commutator. A half-loop dynamo with any considerable e. m. f. must have a very large magnetic flux or a very high speed, or both. Consequently, commutatorless dynamos of the kilovolt order are disordered fancies, of the hektovolt order are dreams, in the dekavolt order are read about, and in the volt order are sometimes seen. It is possible, of course, to roll a number of such volt machines into one, by dividing up the armature into insulated strips and connecting these in series by slip rings and brushes; but the simplicity of generation is soon lost in a forest of brushes. Brush friction is the bugbear of the whole principle.

For very low pressures there is, no doubt, as Mr. Heath's article points out, a distinct advantage in the commutatorless type of dynamo. Its e. m. f. is steady if its speed is uniform, and its armature reaction is very small. Its efficiency is apt to be low, owing to brush friction, but the same is generally the case with low-pressure machines of the despised commutator type. If a brush contact mechanism could be designed which would collect powerful currents with negligible mechanical friction and insignificant contact resistance, the low-pressure commutatorless dynamo would be well nigh perfect. But then, the charm of discovering possible improvement in it would be banished. Meanwhile, the money value of all the effort spent upon producing a high-pressure commutatorless machine should command respect.

We feel compelled to raise our voice in protest against the term "unipolar dynamo." Its inaccuracy has been pointed out by nearly every recognized writer, and there should be a commandment delivered unto all technologists—Thou shalt not perpetuate misnomers. There are many of our busy confrères who declare that amid the cares of office and duties to machinery they have no reserve courage to enlist on behalf of terminology, and that life is too short to permit of exterminating errors in words. It should be remembered, however, that an inaccuracy in language tends to mislead as well as to confuse, and that carelessness on the part of those who know better induces error on the part of those who know less. If the first of January had not already carried six weeks in its train, we would recommend all our friends to make a good new year resolution never to say "unipolar dynamo," because it is inaccurate.

POLYPHASE MOTORS FOR TRACTION.

In spite of all that has been said on this rather hackneyed subject, few engineers outside of those who have been personally engaged in the development of the induction motor, realize the difficulties which must be overcome to adapt this type of motor to traction purposes. The impression prevails generally that these difficulties are solely those of three conductors, the inefficiency of the motor at all speeds except those near synchronism, and the inductive drop caused by the lagging currents which are an invariable accompaniment of induction machines. This impression has recently been fostered by the comments of engineers as prominent in the profession as Prof. S. P. Thompson. In addition to the disadvantages above named, which are not very serious, there are others which are worse. In the first place, the induction motor depends upon alternating currents for the excitation of its magnetic field, and these exciting currents necessarily lag behind the impressed e. m. f. As they pass through the active windings of the machine in which the counter e. m. f. is developed, the number of turns around which they circulate is necessarily small as compared with the number of turns, for instance, in a direct-current shunt motor, and the exciting or lagging currents must be correspondingly large.

An idea of the relative magnitude of these currents and those required for direct-current shunt excitation of the same magnetic circuit can be obtained by considering two alternators running in parallel with each other. If the exciting current of one is entirely withdrawn it will continue delivering the same voltage as the other machine with which it is in multiple, being excited solely by wattless currents passing between the two armatures. These wattless currents will, however, be enormous compared with the small direct current which normally excites the same magnetic circuit, on account of the far greater number of turns in the field than in the armature circuit. The wattless currents in this case would be in most machines as great as, or greater than, the rated load output. Induction motors are excited in exactly the same way and, if their magnetic circuits possessed as high reluctivity as those of alternating-current generators, the wattless currents required would be as great. On this account a prime essential in the design and construction of induction motors is the reduction of the reluctance of the magnetic circuit. This is accomplished in the first place by a reduction of the air gap to the minimum possible limit. In high grade commercial machines now on the market in this country the air gap is reduced to less than 1-16 of an inch and down to 1-64 or less in small sizes. Great care must be taken to assemble the punchings of rotor and stator to a true circle and to get the most accurate alignment of bearings and stator. In some cases the laminations are ground to a true cylindrical surface after being assembled. This is a condition quite out of the question in ordinary traction work, where bearings cannot be maintained in alignment to 1-100 inch, and where the constant distortion of the truck running over an uneven roadbed continually causes some relative motion between the field and the armature.

The necessity for reducing the exciting current also limits the density of magnetism under which such motors can be worked. It is common to run induction motors at a magnetic density somewhat less than half that customary in direct-current constant-speed motors, and perhaps about one-third that of traction motors when exerting a fairly large torque. With the same peripheral speed this requires a correspondingly heavier motor for the same horse-power output, a serious limitation in traction work. To be sure, the induction motor is somewhat more compact than the direct-current motor, the magnetic field in its external stator running by way of the shortest possible path from pole to pole, while the direct-current motor has a considerable inward radial projection from the yoke, requiring a greater external diameter for a motor of the same diameter at the air gap. Still another feature enters, and that is the question of frequency. A low frequency is inexpedient on account of the increased cost of transformers. Induction motors require a fine subdivision of windings into many slots in order to reduce the self-induction of the coils. With frequencies commercially available—25 cycles or more—a low-speed motor would have so many poles that the distribution of its winding in a sufficient number of slots per pole would become utterly impossible. On this account, and in order to obtain a sufficient output of power per pound of material, it is customary to run induction motors at very high peripheral speeds, from 6000 to 8000 ft. per minute, a practice which is justified in stationary work by the solidity and simplicity of the rotor. In traction work, however, high peripheral speeds mean either double reduction gears which no progressive engineer would tolerate, or a large diameter, for which there is not room on the ordinary car truck.

These objections may be answered by advocates of the induction motor, especially those working in Europe, by reference to the various successful polyphase traction systems there at work. The conditions in these installations, however, are entirely different from general American practice. With the sole exception of one road, that in Lugano, they are mountain railways worked with locomotives and with triple-reduction gears. These installations are special, with a very limited number of cars, and receive intelligent care from skilled engineers. Accomplishments successful with small special roads of this kind are no guide as to what is possible in large systems subject to the abuse of American overloads and rough usage. As one American traction engineer has tersely put the case, "A two-car road can be run with an arc machine, but a 200-car road is a different proposition."

Prof. Crocker on the Electrical Far East.

A large gathering of the New York Electrical Society, including several ladies, listened on Tuesday evening to an address by Prof. F. B. Crocker, at the College of the City of New York, upon his observations on electrical matters in the Far East, including China, Japan, the Philippines and India. The address was accompanied by a number of lantern slides. Prof. Crocker compared American and European opportunities for trade with the Far East, and held that as the Pacific gave us much the freer and shorter path, the advantage was with us. Moreover, Europe imported electrical apparatus from us, so why should the Oriental import from Europe rather than from us? In short, the openings for American trade in the east were infinite if we saw to it that the doors were kept open. Broadly summing up the attitudes of the people he saw, the Japanese were eager and progressive. The Chinese were non-progressive, but would add new to the old, while the Hindoos were utterly inert and indifferent. The Japanese were the only really progressive people there except the Filipinos, who were still, however, largely savages. Prof. Crocker showed on the screen, by the way, two Filipino telegrams, he had picked up with others, showing that long before the "accidental outbreak" of hostilities the natives were getting ready large quantities of dynamite and munitions of war.

The lecturer discussed the racial differences, and scouted the idea that the Chinese were more honest than the Japanese. He pointed to the fact that in Japan a telegram could be sent for 7½ cents, yet the government cleared one-third of that as profit, indicating strict probity throughout the service. In Japan, he found electrical instruction excellent, the best and latest books and material being used. When a student was sent abroad, he went to the country best suited to his special line of work. Views were shown of telephone work in Japan, electric light plants and work in Honolulu, Burmah, Calcutta, etc., and telegraph work in China and India. Prof. Crocker considered the telegraph lines built by the British Indian government as the finest in the world.

As to the general outlook, the telegraph and telephone were adapted to the east because they saved trouble. Therefore they paid. Electric lighting paid, as it was the best form of illumination for such hot countries. Electric railways paid, as did steam, even with low fares, because the Oriental dearly loves to travel around. It was true, labor was extremely cheap in the east. He had seen women carrying brick for the 150-foot chimney of the Calcutta electric light plant, at 6 cents a day, and skilled labor was obtainable at 25 cents a day. But he had taken ordinary cases and had found that small electric motors would do the work of men at one-twentieth the actual cost, as measured by the result and output.

Dr. R. Ogden Doremus moved most eloquently a vote of thanks to Prof. Crocker, approving the remark of President Dunn that it was well to see the east through such an "electrical eye."

Société Internationale des Electriciens.

The January meeting of the Société Internationale was devoted to discussion of the long distance transmission of power by the series direct-current system.

M. Cuenod sketched the principles of the direct-current system, and spoke of its economic advantages. No transmission, he said, could be economical if the price of an annual horse-power exceeds $30, and the cost of installation should not exceed $200 per horse-power. He referred to the fact that M. Thury laid down in 1889 the first plant for series long distance transmission by direct current, 140-hp being transmitted four miles. At the end of 1899 plants installed on the Thury system were transmitting an aggregate of 16,300-hp from generators, each giving a maximum of 3600 volts. M. Cuenod directed attention to the fact that in this system the current remained constant, the voltage being variable. He considered that the direct current is superior to the alternating current system. The efficiency of the direct-current generators used are equal to that of the best alternators, while the absence of transformers and line inductance conduced to superior economy. A saving of from 15 to 20 per cent. in economy over the alternating-current system could be obtained, and better results derived from the use of direct-current motors.

M. Thury followed M. Cuenod, and explained the different apparatus used with his system. He projected on a screen representations of a motor-starter, a short-circuiting appliance for use with motors, a special double-pole switch, and an arrangement to prevent sparking at the moment of starting up. The maximum voltage thus far employed by M. Thury is 12,000 volts, though he expects presently to make use of 22,000 volts.

Lighting Effects for the Pan-American Exposition.

Mr. Luther Stieringer, the consulting electrical engineer of the Pan-American Exposition, has submitted to Director General Buchanan a most able and exhaustive report on the electrical illumination, distribution, etc., of the great show to be held at Buffalo next year, and Mr. Henry Rustin, chief of the mechanical and electrical bureau, has already begun to lay out the plans which shall provide for both the spectacular and the useful electrical work.

A part of Mr. Stieringer's report has been made public, and it is needless to say it embraces a wealth of experience and a variety of happy ideas. Mr. Stieringer has been interested in this class of work for years, and such exhibitions as Chicago, Omaha, Atlanta, etc., testify to his success in handling light as a medium for beautiful display and grand decorative effect. In the present case, with the Paris Exposition intervening, the Pan-American directorate have been desirous that their nightly spectacles, coming a year later, shall in no wise suffer by comparison, and shall also be in every way original and distinctive.

Briefly outlined the plans are as follows: The court of fountains, flanked by the main buildings and by the esplanade with its sunken gardens of tropical flowers, is to be 1700 feet long and has an area of 850,000 square feet. This court will be brilliantly lighted without the aid of a single arc lamp. Over 100,000 incandescent lamps of 8 and 16-cp will be used, affording a highly diffused illumination with no intense points of brilliancy, in fact, a bright light without shadows. At the north end of the court of fountains will be the electrical tower, designed by John G. Howard, of New York, member of the Board of Architects. It is to be 300 feet high and in front and facing the court of fountains, will be a niche 70 feet high and 30 feet wide. In this niche will be a most beautiful water display. A large jet of water will be broken into drops by ingenious devices, and under the powerful electric lights focussed on the jet these individual drops will appear as prisms permeated with color in limitless combinations. Surrounding the tower will be a basin 90,000 square feet in area. In front of the niche will be an illuminated cascade, the water of which will finally flow into the basin where there will be numerous allegorical conceptions of statuary rising from the water. These figures will be surrounded by fountain effects to surpass those of the fountain designed as one of the main features of the Paris Exposition.

Designs are being prepared for electric fountains which will be used in the embellishment of the interior courts of the several buildings. Plans are also being considered for the illumination of the Grand Canal, which will have a stretch of several miles. Detailed plans are now being made for the treatment of the large lake known as Gala Water, at the southern end of the grounds. The lake lies in a depression and its banks slope at an easy grade, thus forming a natural amphitheater affording spectators the best opportunities to view the attractions on the lake. The features will be mostly of floating nature and easily placed on the water without damage to lake or park. The ideas are far enough developed to show the advantageous position of Gala Water will allow the production of a great variety of electrical effects that no preceding exposition has been able to obtain owing to the interference of buildings and the presence of necessary lighting that frequently mar the best schemes of illumination.

One of the many novelties proposed is an electrically luminous air fountain capable of an iridescence and color effect and peculiarity of form never before seen. Advantage will be taken of the opportunity for electrical figure work in the water basin. It is promised that this display will be exceptionally pleasing. Thousands upon thousands of lights will be required for the exposition. An idea of the electrical requirements of the enterprise is afforded by the statement that illumination must be afforded for more than 250 acres of buildings and grounds. It is a rather curious and interesting fact that some of the new effects with water were experimented on by Mr. Stieringer in the nearby Niagara Whirlpool Rapids a few years ago, before the Pan-American Exposition was contemplated.

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European Types of Electric Automobiles.

IN order to enable comparisons to be made between American and European practice in the design of electric automobiles, we give below descriptions of vehicles made by several of the more important manufacturers abroad:

One of the most enterprising automobile manufacturing firms abroad and one which has introduced many novel features, is Henschel & Co., of Charlottenburg, Germany. One of the best known of the Henschel type of vehicles is the electric phaeton, shown in Figs. 1 and 2, and built for two passengers. It has a removable top, which, when taken off, will lighten its weight in good weather.

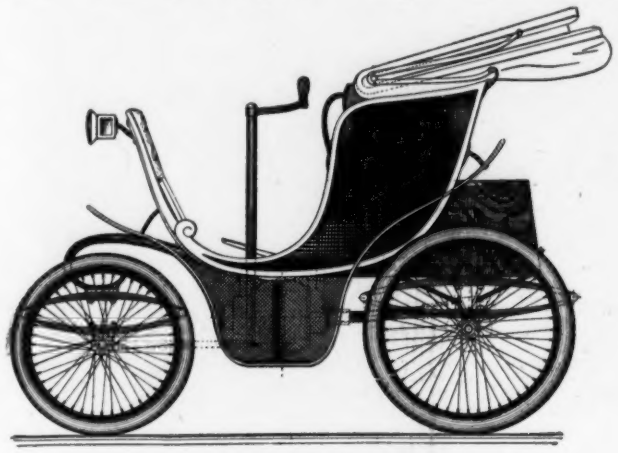


FIG. 1.—HENSCHEL PHAETON.

It will run 30 miles on one charge, which can be increased by the installation of a larger battery. The braking is accomplished by means of two mechanical brakes, but in case of necessity electrical braking can be resorted to. The vehicle is listed at $1050. In Figs. 3 and 4 are shown two views of their electric coupé. The motors, *M*, are located in the semi-circular space beneath the driver's seat. Each operates independently of the other and transmits the power by a worm to a small worm gear near the rear axle, which in turn drives the rear wheels by means of a chain. In order to avoid any strain or bending of the worms the latter cross each other—that is, the one from the right motor drives the left rear wheel and the left worm drives the right wheel. The motors are so connected in the controller that either can propel the vehicle should one of them be damaged, naturally at a reduced speed. The battery, *B*, furnished by the Hagener Abkumunlatorenfabrik A. G., is located

FIG. 2.—HENSCHEL PHAETON.

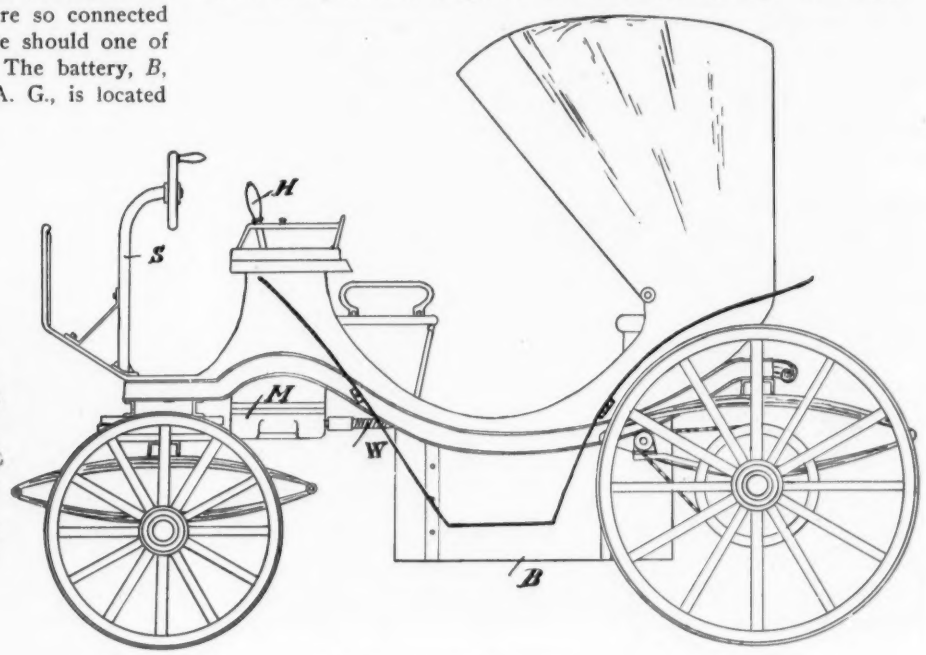


FIG. 3.—HENSCHEL COUPE.

in a box beneath the vehicle floor and can be removed in two or three minutes and a new battery put in its place. There are 44 cells, which have a capacity of from 60 to 70 ampere-hours, and will propel the vehicle 18 to 24 miles on one charge. Each motor has a capacity of 2-hp at 1100 r. p. m. at a pressure of 85 volts. The weight of the two motors is 220 pounds. The steering apparatus, *S*, is also operated by a worm, with the right hand, while the controller is operated with the left hand. The mechanical brake is operated by the foot, and brakes the motors as well as the rear wheels. The seating capacity is five persons, besides the operator, and the vehicle weighs 2750 pounds without a load. Its speed is eight miles per hour. The price quoted for this vehicle is $1450.

Another interesting and practical novelty manufactured by this company is the portable loading station for electric vehicles, shown

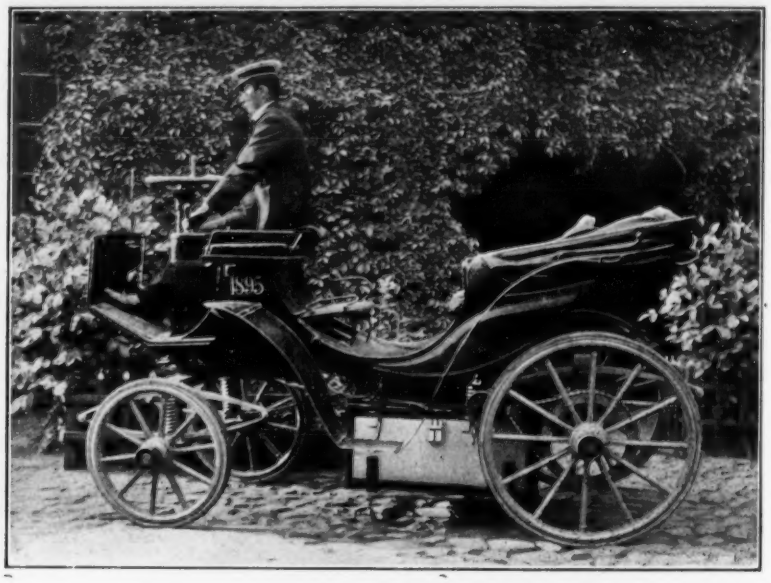


FIG. 4.—HENSCHEL COUPE.

in Fig. 5. It is of obvious value for owners of automobiles and innkeepers, as it can be used for lighting purposes in addition to charging accumulators. It consists of a small benzine motor directly connected to a dynamo. To compensate for the irregularity of the speed of the motor, a very ingenious electric regulator has been devised which, as soon as the pressure varies, so affects the electric igniting apparatus as to restore the normal speed of the motor.

Fig. 6 represents an electric express wagon, made by Paul Schutze, Oggersheim, Germany. It consists of a movable front wheel base and platform, the supports of which are so shaped as to form a secure and protected receptacle for the storage battery. The latter can be reached from the top after a watertight cover has been removed, and without any trouble the several cell connections may be inspected. This manner of housing the battery enables the builder to give the wagon a graceful form, which is impossible with the suspended battery boxes. The back portion of the platform is supported on springs, which are directly connected to the axles and

wheels, while the front portion is supported by the movable wheel base, the wheels of which are also attached to springs. The car platform is connected to the front wheel base by a pivot with a ball and socket joint, which allows the front wheel base to be turned in any desired position, which can be accomplished from the motorman's seat by means of a steering wheel. The front wheels being the driven ones, and it being possible to have them make any desired angle with the longitudinal axis of the wagon, makes it possible to turn the smallest curves.

The electric motor and the driving mechanism are also attached to the front wheel base and are enclosed in a dustproof case. The speed of the wagon is regulated by a controller, which is situated at the left of the operator and is worked by means of a handle. A pointer shows him which way to turn in order to go forward, backward or come to a standstill.

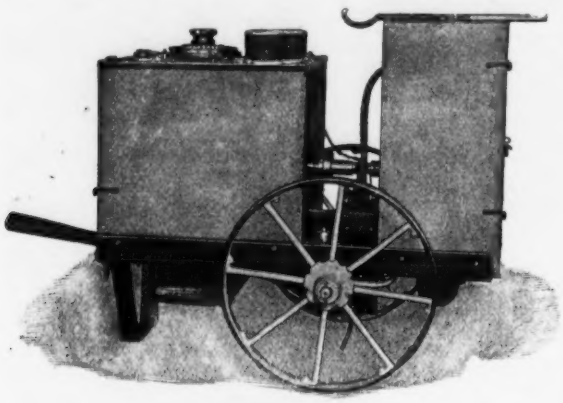


FIG. 5.—AUTOMOBILE CHARGING OUTFIT.

FIG. 6.—SCHUTZE ELECTRIC EXPRESS WAGON.

By properly apportioning the weight on the two front wheels the required adhesion to the ground and the resultant tractive force are obtained so that even on wet ground the wagon has the necessary amount of adhesion to start.

With a single charge of the battery the wagon can travel a distance of about 20 miles, the distance varying with the condition of the road. The wagon runs well on pavements and is therefore well adapted for city use. It can be started without any previous manipulation, which has the advantage that any ordinary driver can learn to master its operation in a brief space of time.

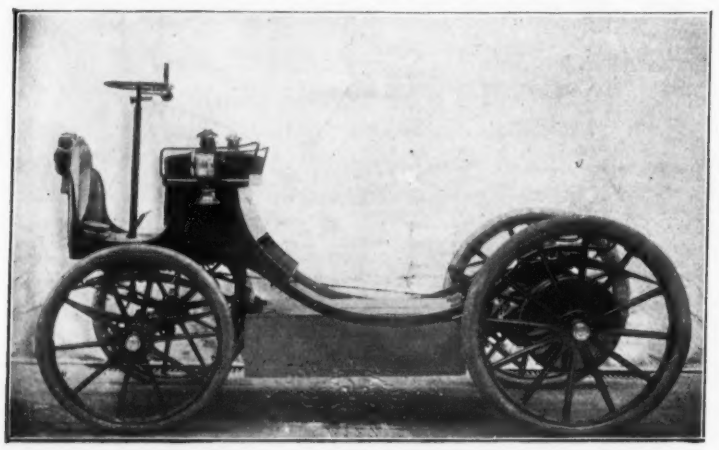
The operating cost of this vehicle is claimed to be very small. It is stated that to run a loaded wagon 20 miles at the Berlin rates for current of 4 cents per k w-hour, would cost 85 cents.

Figs. 7 and 8 illustrate one of several types of electric vehicles made by Jacob Lohner & Co., of Vienna, Austria. As will be seen from Fig. 7, the carriage frame is a separate and strong construction, the body proper being made removable. The single motor is of the double armature type, and with the battery in two groups, and a rheostat, allows of no less than twelve combinations at the controller, as shown in Fig. 12. The storage battery consists of 44 cells, weighing 1100 pounds, and having a capacity of 200 ampere-hours at a 30-ampere rate. The motor is geared 1.65. On a single charge this vehicle has run 40 miles at a rate of 15 miles per hour, and ascended a grade of 4 to 6 per cent. over a distance of six miles in one hour and twenty-five mnutes. The motor has a normal capacity of 3-hp at 350 r. p. m., but can be run up to 5-hp.

Fig. 9 illustrates an electric carriage made by the Société des Voitres Electriques et Accumulateurs, of Paris, France. A single double armature motor is used and hermetically enclosed in a steel case. The two armature windings are in proportion of five to three, which permits of four different combinations, corresponding to speeds of five, seven, twelve and twenty miles an hour. The speed of the motor is from 600 to 2000 r. p. m. The advantage claimed for this method of varying the speed is that four different speeds are obtained without changing the battery connections or the field excitation.

The battery consists of 42 cells each weighing 33 pounds. By means of a controller and resistance, six speeds ahead are obtained on some of the vehicles this company manufactures, three speeds astern and three different powers for braking, the motor in the latter case being used as a generator. To obviate shocks in starting up, a strong spring is interposed between the chain pinion and the wheel, which permits the motor to make five or six revolutions before the wheel begins to turn. In the electric vehicles made by this company chain transmission is used, one of the advantages claimed for which is that it enables a motor to be more completely hidden underneath the carriage body.

Fig. 10 shows an electric fire wagon made by the same company. The vehicle itself weighs 3800 pounds and with a single charge will run for four or five hours at the rate of nine to twelve miles per hour. The reel carries 500 feet of hose. The motor is of 4-kw and the battery consists of 44 cells, having a total weight of 1140 pounds, and a capacity of 160 ampere hours, on a discharge rate of six hours.



FIGS. 7 AND 8.—TYPE OF LOHNER ELECTRIC VEHICLES.

Fig. 13 illustrates the details of a charging post made by the same company. The various appliances shown consist of a cut-out, a circuit breaker and a polarized ammeter. The plug at the end of the cord is entered in a receptacle in the vehicle to be discharged.

Fig. 11 shows a combination gasolene and motor electric carriage

made by Etablissements Pieper at Leige, Belgium. The gasolene engine is a one cylinder machine of 3½-hp. The cylinder is cooled by cast-iron wings, and the jacket and valve boxes have a water circula-

FIG. 9.—FRENCH ELECTRIC CARRIAGE.

tion, the water for cooling being in a small tank above the engine. The electric motor is of 2½-hp, but for short periods can be worked

FIG 10.—ELECTRIC FIRE HOSE WAGON.

up to five or 6-hp. The storage battery consists of 40 cells in an ebonite box, and weighs about 250 pounds. Change of speed is obtained by means of an arrangement of reducing gears.

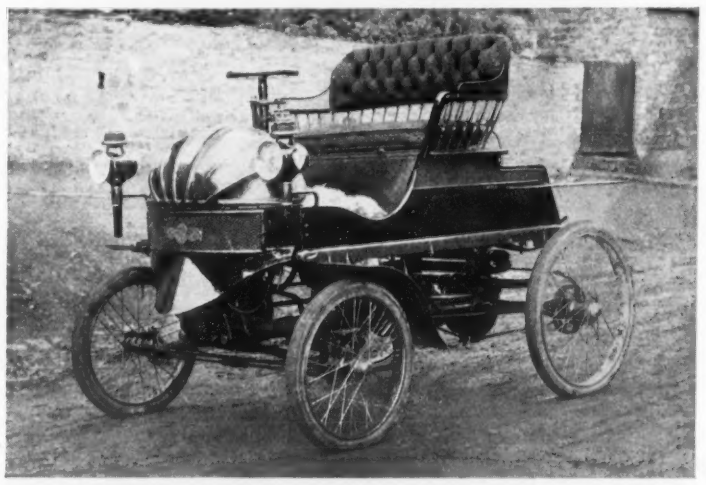


FIG. 11.—PIEPER COMBINATION GASOLENE AND MOTOR CARRIAGE.

In starting up, current from the battery is sent to the dynamo, which brings the gasolene motor into action. During stoppage all the power of the gasolene engine is used to recharge the batteries. When in motion the electrical machine is a dynamo or a motor according to the power required for driving. If this power is inferior

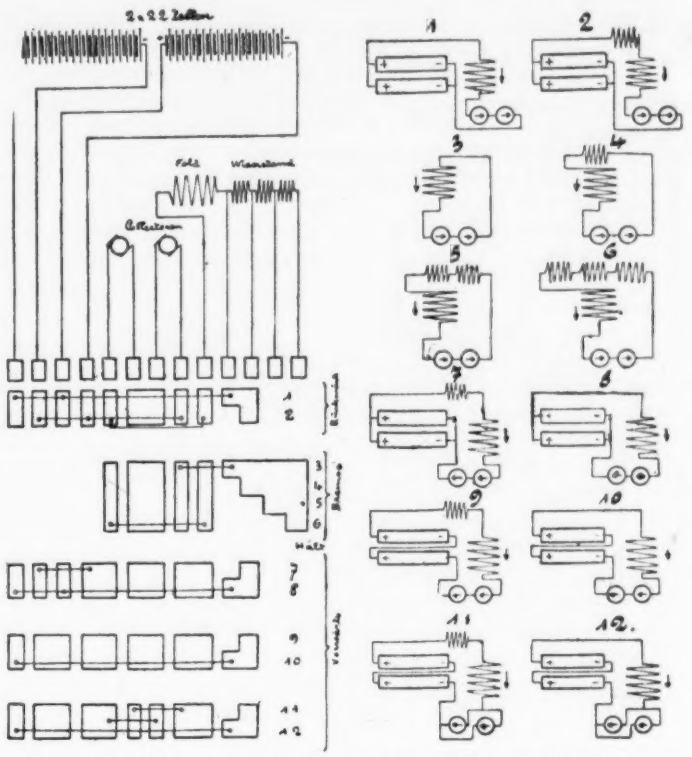


FIG. 12.—DIAGRAM OF CONTROLLER AND MOTOR CONNECTIONS.

to that of the petroleum motor, the surplus goes to the battery. If, on the contrary, it is superior to that which the gasolene motor can supply, as at starting or going up an incline, it becomes a motor and assists the gasolene engine, taking current from the battery. All these operations are automatic, requiring no manipulation on the part of the driver. The speed changing gear is fixed directly on the electric motor shaft. In order to transform rapidly to a simple elec-

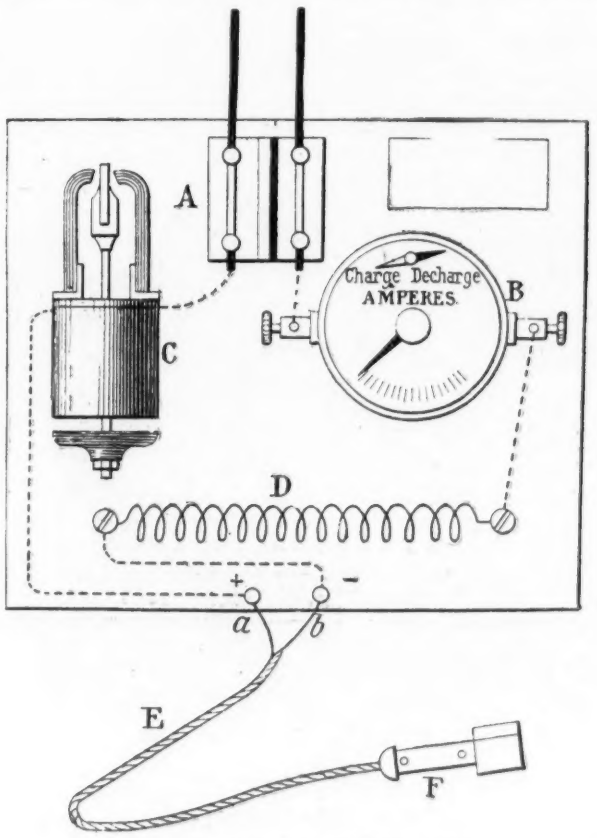


FIG. 13.—DETAILS OF CHARGING POST.

tric carriage, there is a friction coupling by means of which the engine can be quickly disconnected.

Notes on Commutatorless Dynamo Design.

BY H. E. HEATH.

ALTHOUGH many engineers believe that the production of a commercially practical high voltage unipolar or continuous pole dynamo is impossible, yet, if there should be sufficient demand for such apparatus, it seems more than probable that the apparently impassable difficulties would prove to be only apparent and any one of a number of designers would have little trouble in producing a satisfactory machine of that description. Be that as it may, there are few who will deny the possibility and desirability of such dynamos for low voltages, and the following notes briefly describe several forms that seem to possess some advantageous features.

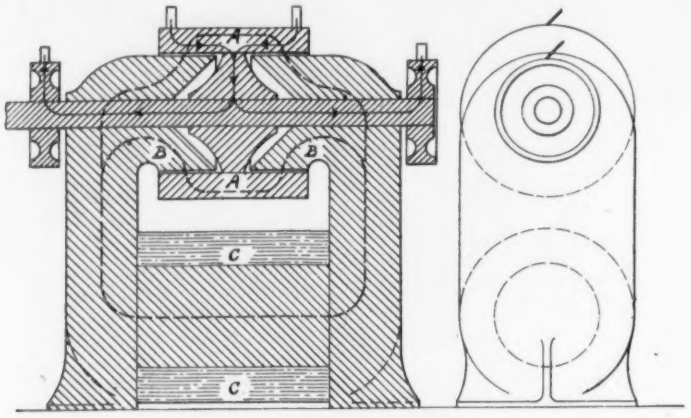


FIG. 1.—UNIPOLAR DYNAMO.

For many electrochemical, and particularly, electrometallurgical purposes, the current derived from such a dynamo is decidedly superior to that produced by any other form of machine, and equaled only by that obtained from a battery; but, as the cost of operation debars the battery from any extensive use for such work, a comparison need only be drawn between the currents produced by the two forms of dynamo. With the ordinary form of low potential dynamo, while the voltage may appear to be constant, yet the current is to such an appreciable extent pulsating, owing to the few commutator segments, that it is not, perhaps, surprising to observe the superiority of the work due to the perfectly smooth, non-pulsating current from a unipolar machine.

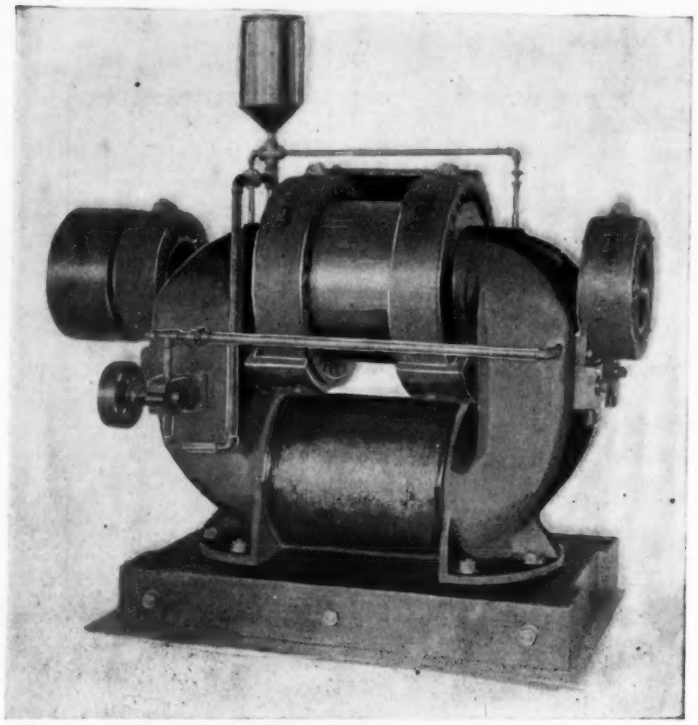


FIG. 2.—UNIPOLAR DYNAMO.

Other and better papers have rendered all theoretical description unnecessary, but it may be well to say that the seemingly perfect form seldom proves such in practice, and, in this case, by considerably lengthening the iron part of the magnetic circuit, several advantages are obtained with little loss, a large portion of the reluctance being in the gap.

In the design of these machines the greatest difficulty will be found to be in the proper collection of current; and, owing to the high velocity at the collectors, considerable care will have to be exercised to prevent undue loss and heat at these points. The collecting devices should be easily accessible, and, at the same time, must be so distributed that the flow of current in the armature will be uniform throughout, as any inequality there will produce high iron losses. The armature reaction has little or no effect, and none could be expected other than a slight increase in reluctance.

The following machines seem to fill the above requirements:

Fig. 1 shows section and end of a machine that has been constructed, and from which excellent results were obtained. *AA* represents the armature, *BB* the poles and *C* the exciting coil; the electrical path being shown by the continuous line and the magnetic circuit by the dotted. Fig. 2 is a photographic reproduction of a view of this machine as actually made. Fig. 3 shows another simple form. Fig. 4 shows a form for higher potential work. There is little doubt that several other similar forms could be produced.

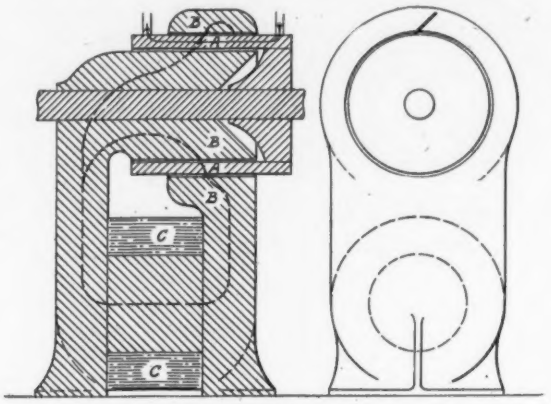


FIG. 3.—UNIPOLAR DYNAMO.

With the machine shown in Figs. 1 and 2, although there might appear to be considerable drop at full load amounting at times to as much as one-third-volt, yet careful testing has failed to show that any of this is due to armature reaction, and it has been proved to be I^2R loss in the collectors and sliding contacts. This drop is not of so much importance, as increasing the exciting current will easily compensate for it.

In fact, to secure satisfactory operation without undesirable rise in temperature, it has been found advantageous to have a certain amount of drop in the collectors, as experience has shown that a point can readily be found such that any increase in drop, caused by adjustment, will increase the heating on account of excessive I^2R loss, and any decrease in drop, also due to adjustment, will increase the heating, because of the friction loss due to the necessary pressure on the revolving collector rings.

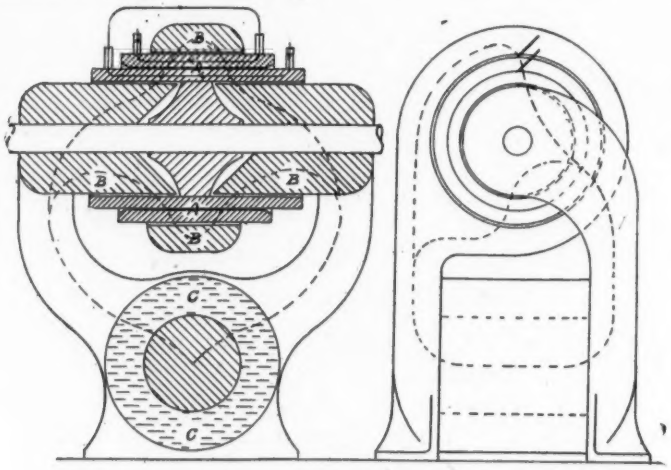


FIG. 4.—UNIPOLAR DYNAMO.

When running, it is impossible to tell from the appearance of this machine whether it is loaded or not, even though it may be carrying more than 50 per cent. over rated capacity, and, indeed, the only load limit seems to be that determined by the permissible rise in temperature. Although it would be possible with the forms shown in Figs. 4 and 3 to use other than iron armatures, in the case of Fig. 1

such other armature would be impractical; and in any form, when properly designed, the advantages of iron are so pronounced, and the disadvantages so immaterial, that the use of other metals cannot be recommended for this purpose. For magnetic reasons, the section of the armature must be so great that its resistance is inappreciable.

With regard to the form shown in Fig. 3, the shorter electrical and magnetic paths, and the necessity of only two collectors and one bearing, may, in some cases, render this form more desirable than that shown in Fig. 1, but these advantages are, to a certain extent, counterbalanced, so that there is little reason for choice between the two.

In Fig. 4 a form is shown by means of which any reasonable voltage may be obtained without the necessity of enormous revolving masses of metal, it being only necessary to have the required number of concentric armature tubes with their collectors properly connected. This result could also be obtained by having the armature a single tube, cut longitudinally into bars having independent collectors. It is, of course, understood that most of the remarks with reference to Fig. 1 will apply equally well to Figs. 4 and 3.

Rather more than four years ago the Eddy Elec. Mfg. Co. was requested to furnish a machine for a certain class of work with a low voltage and large current, and it seemed almost necessary in order to obtain satisfactory operation that we should, if possible, design a unipolar machine. After considerable study in the matter we produced the machine shown in Figs. 1 and 2. Upon test it apparently filled the requirements in every way, and is in satisfactory operation to-day, although shipped in the early part of 1896.

This machine was separately excited, the loss in field being about 700 watts. As shown in Fig. 1, the electrical circuit was through the shaft, and in order to get low resistance the shaft was made of Tobin bronze. On account of the long bearing surface, heavy weight and high speed, we found it desirable to use a pump and force a circulation of oil through the bearings, and when we did so had no trouble whatever from heating. The pump shown in Fig. 2 was only used to return the oil to the reservoir, as we depended upon gravity to give us the feed required.

One of the points we expected to have trouble with was the possibility of high core losses in the iron armature, due either to unequal distribution of magnetism or eddy currents. The uneven distribution of magnetism was avoided by the form of pole and armature used, and as the current drawn from the armature should be as equally distributed as possible, we not only used a large number of collecting brushes, but we also, on each end of the armature, placed a copper ring so that the current would flow naturally to the nearest point of the better conductor and through that to the collecting brushes. In actual operation we found it to be fairly satisfactory, the core loss due to the unequal distribution of the magnetism, being less than 100 watts, and that due to eddy currents practically nothing; at least, by any method that we could use we were unable to find any such loss.

By actual test with this machine we were able to run it at the load required with a drop in the machine of one-quarter of a volt, this drop being in the collectors and contacts. While at that time we were in somewhat of a hurry to ship the machine, and had not at hand very accurate instruments for testing the high currents, at the same time we were able to draw from it more than 9000 amperes without any difficulty, the machine giving 1½ volts at a speed of 1200 revolutions per minute.

Except for the small size of the pulley, and certain other difficulties that came up, there seemed to be no reason why almost an unlimited amount of current could not have been drawn from it if it had been necessary to do so, the limiting element merely being the heating of the machine at the collectors. The maximum density in the magnetic circle was about 15,700 gausses, this being in the field core, and the density in the armature was nearly as great.

The diameter of the armature, outside, was 15 inches, the diameter of the pole ends being 10 inches. The shaft was made rather larger than necessary perhaps for strength, as the construction shown in Fig. 1 made it almost impossible for any springing to occur. But this extra diameter of course, cut down the resistance and did no particular harm. We found it necessary, however, to put steel collars on the shaft in order to get sufficient durability.

The current-collecting devices were so designed that the contacts could be simultaneously adjusted, and we had no trouble whatever in operating them, the friction being no more than should be expected where there was so much surface contact. That a machine of much higher voltage and also higher current, could be constructed on the same lines there seems to be no doubt, and is necessary we should not hesitate to take an order for such a machine and guarantee results.

Experience would thus far seem to prove that for the production of large currents at low voltages this form of machine is much simpler and more efficient than the forms ordinarily designed for such purposes.

The Hysteretic Qualities of Iron Viewed from the Molecular Magnet Standpoint.

By Dr. Samuel Sheldon.

THE subject of this investigation was suggested by two related phenomena which were observed in connection with other work. The first phenomenon was that a soft iron wire, when twisted by one end's turning with the chuck of a running lathe while the other end was held stationary in a handvise, invariably became magnetized without being subjected to any discoverable magnetizing force. This magnetic condition persisted and a determination by means of sudden withdrawal from a coil connected with a ballistic galvanometer revealed an induction density of about 2000 lines.

The other phenomenon occurred when a handful of minute watch-charm compasses, having cases of small diameter and strongly magnetized needles, were arranged in an orderly row upon a desk. Although the line along which they were arranged had an east-westerly direction, the needles arranged themselves with their axes in this direction. They appeared to be unaffected by the earth's field. When adjusted so as to touch each other, and to regularly cover a rectangular space (not square) they arranged their axes in the general direction of the longer side of the rectangle. Upon increasing the distances between the centres of the compasses a certain distance was obtained when the needles began to orient themselves according to the direction of the earth's field.

These two observations led to the supposition that the retentivity of magnetic substances might be dependent upon the distance between their molecules; and that the other factor of hysteretic quality, viz., coercivity might be similarly dependent. These suppositions were a direct consequence of Ewing's molecular magnet theory. According to this theory conditions necessary for the production of a strong permanent bar magnet are that the molecules shall be compacted as much as possible in the direction of the length of the bar. When a wire is twisted in a lathe the molecules are compacted laterally but not longitudinally. To test whether a longitudinal compression would give greater induction densities than twisting, a rod of soft iron was introduced into a hole bored in a brass block and was then placed upon an anvil and hammered upon its end. The result was disappointing, as no permanent magnetism was discoverable.

Attention was then turned to the watch-charm compasses with the idea of discovering the influence of arrangement upon the retentivity, coercivity and hysteretic quality of the gross magnet complex of compasses considered as molecules. To know these qualities means to know the relations which exist between magnetizing force and the induction density which it produces.

To free the compass needles while under observation from the influence of the earth's field, this field was neutralized by an auxiliary magnet. A large bar magnet was suspended in the direction assumed by a dipping needle so as to neutralize the earth's field over a small space upon the table, which we will call the centre of observation, and where the compasses were to be arranged. The perfection of neutralization was tested by placing a sensitive needle in this position. It would assume any position given to it and acted as though it were not magnetized. As magnetizing forces the field of a long bar magnet placed in various positions was employed. These could not, of course, be determined with the same accuracy as could the magnetizing forces exerted by a long solenoid carrying currents of various strengths such as was employed by Ewing, but as the investigation was almost qualitative in nature, accuracy could well be sacrificed for convenience of manipulation and the unobstructed view of the compass needles which was afforded.

As to the absolute value of the magnetizing forces there was no need of concern. The relative values were obtained from observations of the periods of oscillation of a magnetic needle, which was placed at the centre of observation. The reciprocals of the squares of the periods of oscillation are proportional to the magnetizing forces at that point, and are shown in curve No. 1, as functions of the distances of the field producing magnet from the centre of observation.

Linear Arrangement.—When the compasses were placed in a line

with their cases touching each other and the field magnet, arranged with its axis parallel to this line and with its poles so directed as to tend to turn the compass needles through 180°, was approached to the centre of observation, a certain critical distance was reached when the needles would suddenly turn through this angle. Before this distance was reached there was no evidence at the compasses of the presence of the field magnet. A nearer approach was also without effect. Again upon removing the field magnet the new arrangement of the compass needle persisted.

Upon increasing the distance between the pivots of the compasses, reversal took place at a greater critical distance, and furthermore a slight movement of the needles was observed before this critical distance was reached. The increase of critical distance indicates a decrease in coercive force of the magnet complex; i. e., it requires a smaller magnetizing force to reverse it. The preliminary turning as the critical distance is being reached indicates a rounding off of

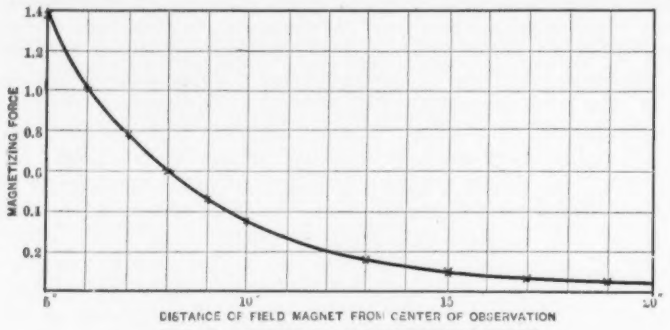


FIG. I.—CURVE OF MAGNETIZING FORCE.

the corners of the hysteresis loop. This distance which produces the first effect upon the compasses we will call the sensitive distance.

The results of the observations made are given in Table I. Columns 3 and 5, are obtained from Fig. 1. To get the results given in column 6, consider that the maximum values of the induction density are when the compass needles are all turned in the direction of the magnetic axis and correspond to a condition of magnetic saturation. This saturation persists until a demagnetizing force of the value given under the heading "Sensitive Magnetizing Force" is reached. By increasing this demagnetizing force the induction decreases in an unknown manner, but upon reaching the critical value, saturation of an opposite polarity is produced. Thus we have three points on half a loop, and by reversing our field we obtain similar points.

Fig. 2 shows the points corresponding to the sixth observation in Table I. As the maximum induction densities for all the loops are the same, the areas may be assumed to be proportional to an average of the sensitive and critical magnetizing forces. The figures in column 6 are proportional to these averages. The curve in Fig. 3 shows the dependence of hysteretic loss upon the distance between the

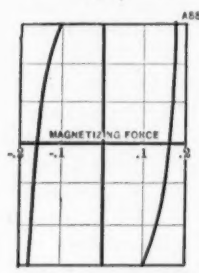


FIG. 2.—MAGNETIZING FORCE BETWEEN SATURATION LIMITS.

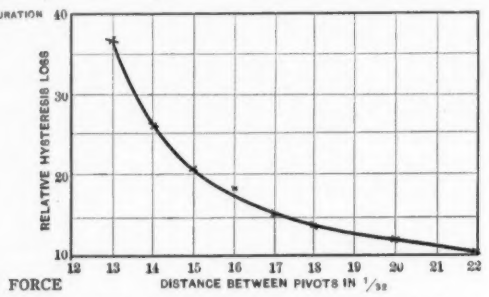


FIG. 3.—CURVE OF HYSTERETIC LOSS.

needles. It will be seen that the losses decrease as the distance increases. It does not, however, approach zero but approaches to a constant value. This constant loss is probably of the nature of a frictional loss, and in the present case is associated with the friction between the compass needles and their pivots.

Multiple Row Arrangement.—The compasses were next arranged in rows parallel to the direction of the magnetizing force. The individual rows, as in the case of a single row, were magnetized in the direction of their lengths. Under this arrangement of the needles, the polarity is more easily reversed, owing to the influence of the rows upon each other. Each row acts in conjunction with the field in reversing the polarity. As the distance between the rows is increased the critical magnetizing force is increased. This is because the demagnetizing influence of the rows upon each other is decreased. In Table II. are given the results of observation on three rows of compasses. The results in the sixth column are calculated in the same manner as those in Table I., and are shown graphically in the curve of Fig. 4.

TABLE I.—LINEAR ARRANGEMENT OF 10 COMPASSES.

Distance between pivots in 1/32 inch.	Sensitive distance.	Sensitive magnetizing force.	Critical distance.	Critical magnetizing force.	Relative hysteretic loss.
13	10.0	.36	10.0	.36	36
14	12.5	.20	10.5	.32	26
15	13.5	.16	11.5	.26	21
16	14.5	.14	12.0	.22	18
17	16.0	.10	12.5	.20	15
18	17.0	.10	13.0	.18	14
20	19.0	.08	14.0	.15	12
22	20.0	.08	14.5	.14	11

TABLE II.—THREE PARALLEL ROWS.

Distance between rows in 1/16 inch.	Sensitive distance	Sensitive magnetizing force.	Critical distance.	Critical magnetizing force.	Relative hysteretic loss.
7	13.0	.18	12.0	.22	20
8	12.5	.20	11.5	.26	23
9	12.0	.22	11.5	.26	24
10	12.0	.22	11.0	.28	25
11	11.0	.28	10.5	.32	30
12	10.5	.32	10.0	.36	34

Conclusions.—Although we may accept the molecular theory of magnetism, it is questionable to what extent we can, with propriety, apply deductions from observations on compass needles to the treatment of iron. The results reached here indicate that an iron to have a small hysteretic loss should have its molecules separated along the direction of magnetization and close together in the direction perpendicular to that of magnetization. These conclusions are in accordance with the results of observations on iron. Rhoades[1] determined the hysteretic qualities of strips cut from various parts in transformer iron sheets as they come from the manufacturer. These sheets are more dense on the edges than in the middle. This results from the method of rolling. They are, furthermore, less dense longitudinally than transversely. Mr. Rhoades' results* are in accord with our conclusions. Ewing has shown that the increase with the time of loss by hysteresis in transformers is the result of continued heating and baking. Iron sheets without doubt behave towards heat in the same manner as rolled brass or copper. Brass screws in binding posts increase in diameter when heated. This increase is permanent. Successive application of heat produces further permanent increase. Roget found that continuous exposure of a good sample of iron for seven days to a temperature of 160° C. trebled its hysteresis constant.

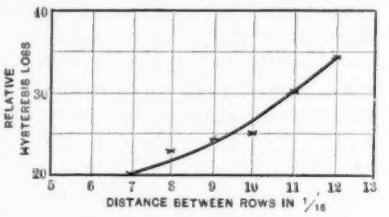


FIG. 4.—CURVE OF HYSTERETIC LOSS.

The observations recorded in this paper were made by Mr. H. W. Loder at the laboratory of the Polytechnic Institute of Brooklyn.

The Gutta Percha Supply.

The growing scarcity of gutta percha has caused anxiety among submarine cable manufacturers for many years, but if a report from Germany is correctly quoted, there is a strong hope that the future supply of this important gum is not as hopeless as it seems. In a monograph just published in Germany it is shown that the Philippines are among the few places on earth in which the trees from which gutta percha is procured will flourish. The trees in Sumatra and Borneo, from which the chief supply has hitherto been drawn, are almost entirely exhausted. The cause of this exhaustion lies in the primitive and destructive methods which were formerly employed for gathering this valuable commodity. The wholesale destruction carried on for years has greatly diminished the annual crop, but the discovery that these trees grow and can be successfully cultivated in the Philippines carry hope that a new mine of wealth has been found for American enterprise as soon as the islands are pacified.

[1]Physical Review, August, 1898.

The Ayrton-Mather Portable Field Tester.

This instrument, first described in 1892,* is a combination of a portable ballistic galvanometer with a test coil capable of sudden reversal in the magnetic field to be measured. The combination is shown in Fig. 1, from which it will be seen that the test-coil, *T*, is attached to a handle, *H*, and connected by flexible leads, *F*, with the terminals of the galvanometer. *G* is the galvanometer case; *P*, the pointer; *L*, a spirit level; *K*, a short-circuit key; *C*, a clamp for securing moving coil during transport; *F*, flexible leads; *T*, the test (or "trigger") coil; *B*, a brass tube attached to *T* and turning within *H*; *H*, a handle for the "trigger coil," and containing the trigger spring; K^1, a key for completing circuit and actuating trigger.

The galvanometer is of the moving coil type so that it may be used moderately near dynamo without its readings being seriously influenced by the stray fields. It consists of a C shaped magnet, *M*, Fig. 2, in the gap of which a long narrow coil, *N*, is suspended. A pointer fixed to the coil and shown at *P*, Fig. 1, moves over a scale graduated to read off directly in c. g. s. units the strength of the field tested.

Connection with the moving coil is made by a phosphor-bronze strip from which the coil is suspended, and the current returns by a spiral whose axis coincides with the suspending strip. The construction of the instrument is such that the galvanometer coil and pointer can turn through one or more complete revolutions, thus giving a long scale on a dial of moderately small diameter.

The test coil, *T*, Fig. 1 (usually called a "trigger coil"), is attached to a brass tube, *B*, concentric with the ebonite cased handle, *H*. This tube can rotate about its axis through two right angles relative to the handle, and when at rest it is kept in either of the two extreme positions by a spring and catch or trigger. When the spring is "wound up," pressing the key K^1 completes the circuit of the galvanometer and coil, then releases the trigger when the coil is suddenly reversed in position by means of the spring. A discharge of electricity is thus sent round the galvanometer and the resulting swing measures the total change of lines of force through the trigger coil.

Fig. 3 shows a cross-section of the trigger coil, the winding being indicated by being double cross-hatched. One end of the winding is connected with the brass block, *A*, Fig. 3, and the other end with the

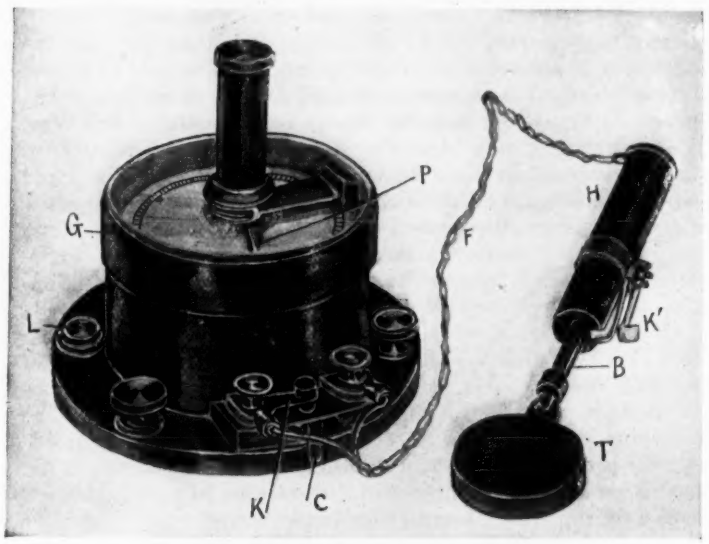


FIG. 1.—AYRTON-MATHER PORTABLE FIELD TESTER.

block, *B*, the latter block serving both as a terminal of the winding and also as a means of securing the coil to the metal plate, *J*, which is attached to the tube, *B*, seen in Fig. 1. The metal cap *Q Q*, Fig. 3, forms the other terminal of the winding and makes rubbing contact by its edges with the plate, J^1, when the coil is screwed home on the screw, *S*. This construction permits of the whole coil being readily detached from the handle, and, as two or more coils of different areas are supplied with each instrument, they can be quickly interchanged. The connections between any coil and the rest of the circuit are made automatically as the coil is screwed home on *S*.

The dial of the galvanometer is usually divided into 200 parts, and one of the "trigger coils" has an area such that the first swing of the galvanometer reads off directly in c. g. s. units the strength of the field in which it is reversed. With this coil, fields up to two to three hundred c. g. s. units may be measured. For stronger fields coils of smaller area are employed, a stock size being such that the readings of the galvanometer multiplied by 10 gives the strength of field in c. g. s. units. To measure the fields in air gaps of dynamos or motors or other confined spaces another form of trigger coil having a sliding movement is supplied. By means of this form of coil the distribution of the magnetic fields under the pole-pieces of machines and

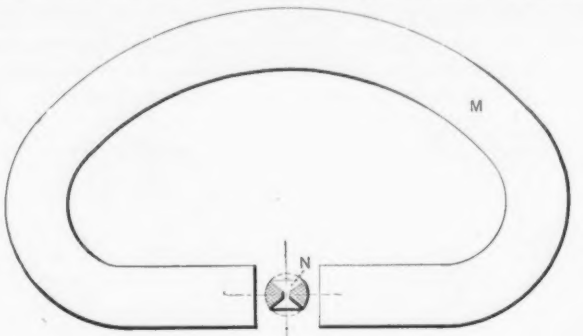


FIG. 2.—PLAN OF MAGNET AND MOVING COIL.

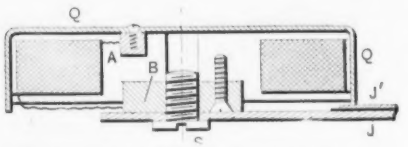


FIG. 3.—CROSS-SECTION OF TRIGGER COIL.

the distortion produced by armature reactions can be conveniently explored.

The main difficulty to be overcome in the design of such an instrument is to obtain angular deflections of the pointer, up to some 800 degrees, which shall be *directly proportional* to the quantity of electricity sent through the galvanometer—that is, *directly proportional* to the strength of field to be measured. For that problem involves important considerations concerning the effect of the damping of the shuttle-wound coil of the galvanometer, *N*, Fig. 2, as it swings, with its circuit *closed* through the trigger coil, in the magnetic field produced by the permanent magnet *M*. It is claimed that this difficulty has, however, been satisfactorily overcome by the inventors in the type of portable field tester described.

*See *Electrician* (Lond.), Vol. xxix, p. 174.

Canadian Niagara Power Development.

The Niagara Falls Park Commissioners have practically agreed, after modifications, to the plans for developing power on the Canadian side proposed by a syndicate of capitalists. The financial terms have also been definitely determined upon, and it only now remains for the engineers of the syndicate to prepare an agreement and specifications in order that the whole matter may be submitted to the Ontario government for ratification. In anticipation of a brisk demand for factory sites, the syndicate has purchased a number of large blocks of land between Niagara Falls and Chippewa, and it expects soon to have its works for the development of electric power well under way. The syndicate proposes to divert water from the Welland River, and by a double use of the flow thus obtained, it will be able to develop nearly 200,000-hp. The water will be brought from the river to a point on the bluffs overlooking Niagara Falls Park. The fall here obtained will permit a development of from 30,000 to 60,000-hp. The second discharge will permit of a further development of 125,000-hp. It is stated that rental for these privileges will virtually be the same as those arranged with the Canadian Niagara Falls Power Company. The latter company has to pay a fixed rental of $15,000 per annum for development up to 10,000-hp. For the second 10,000-hp the rental is $1 per horse-power; for the third 10,000-hp, 75 cents per horse-power, and for all further development 50 cents per horse-power.

National Electric Light Association.

Secretary George F. Porter, of the National Electric Light Association, informs us that the headquarters of the twenty-third convention, to he held in Chicago, May 22, 23 and 24, will be at the Auditorium Hotel. Rates will be $3.50 to $5 a day on the American plan; and $2 to $4 per day for each person, on the European plan.

The Polyphase Induction Motor—II.

(Concluded.)

BY RALPH D. MERSHON.

The preceding section gave the method of obtaining the speed of the magnetic field for a motor having one pair of poles for each of the circuits supplying it. What will be the speed in a motor having a greater number of poles to each circuit?

In Fig. 3 starting with *A1* a north pole and *A2* a south pole (*B1* and *B2* having no magnetization), when *A1* has become a south pole and *A2* a north pole (*B1* and *B2* having fallen to zero) the magnetic field has swept through 180°, or half a revolution. That is to say, when in a motor such as Fig. 3 a pole (*A1*) magnetized by one circuit has interchanged its sign and value of magnetization with the next succeeding one (*A2*) of the poles magnetized by the same circuit, the magnetic field has made half a revolution because these two poles are just half a revolution apart. If, however, there are more than two poles to each circuit, when successive poles of the same circuit interchange their values the magnetic field will not have made one-half a revolution, because successive poles of the same circuit will not be a half revolution apart. Take the case of an 8-pole field, two pairs of poles, that is four poles, being magnetized by each of the 2-phase circuits. In this case adjacent poles of the same circuit are 90° instead of 180° apart. Therefore, when successive poles of the same circuit have interchanged their signs the magnetic field will have swept through

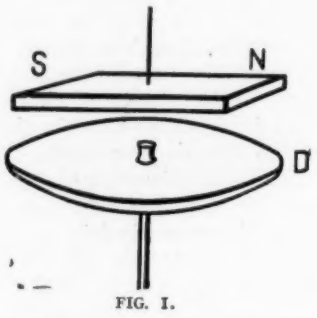


FIG. 1.

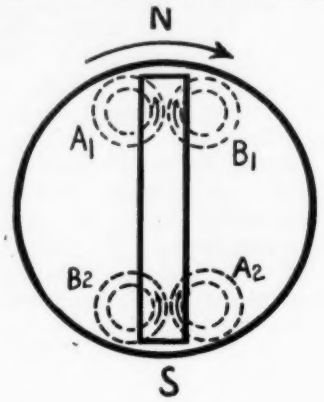


FIG. 2.

only 90° instead of 180°, or through one-half the angle which it would in Fig. 3. Since in Fig. 3, having one pair of poles to each circuit a complete cycle produces a complete revolution of the magnetic field, in the case of a motor having two pairs of poles to each circuit, a complete cycle of the current will produce only half a revolution of the magnetic field. Similarly in a 12-pole frame, that is one in which there are three pairs of poles for each circuit, an interchange of the signs of the adjacent poles of the same circuit will mean only one-sixth of a revolution of the magnetic field instead of one-half a revolution, as in Fig. 3, and a complete cycle of the currents supplying the motor will mean, therefore, only one-third instead of a complete revolution.

It appears that we may find the speed of rotation of the magnetic field, in a given motor, if we know the frequency of the currents supplied to the motor and the number of poles supplied by each circuit. The speed of rotation of the magnetic field will be equal to the frequency of the currents divided by the number of pairs of poles supplied by each circuit. For instance in the case of a 12-pole frame, that is a field having 6-poles or three pairs of poles to each circuit, the speed of the rotating field with alternating currents having a frequency of 60 periods per second, or 3600 periods per minute, will be 20 revolutions per second, or 1200 r. p. m. So far only a 2-phase motor has been treated, but rule for obtaining the speed of the magnetic field will apply to either 2-phase or 3-phase motors.

Although the description given of the action of the induction motor assumes that the rotating field is produced in the stationary element, this is not necessarily the case. Instead of the construction shown in Fig. 7 the rotating member might receive, by means of slip rings, the currents from the line and have the rotating field produced in it. The short circuited winding would then be on the stationary element. The performance of such a motor would be precisely the same as that which has been described. The rotating field would still act in a direction to drag the short circuited member after it, but since the member producing the rotating field is the movable one the result would be a forcing of the movable member around in a direction opposite to that in which the magnetic field rotates.

The statement was made above that the terms "armature" and "field" as applied to the two elements of the induction motor were incorrect. Consider what these two terms signify. The armature of a direct current motor is that element of the motor in which an e. m. f is generated; the field of the direct-current motor is that element in which no e. m. f. is generated. This criterion, when applied to the induction motor, shows that neither element is either armature or field, for both have e. m. f.'s generated in them. In Fig. 7 the stationary element, when fed with alternating currents, has a counter e. m. f. generated in it, just as does an alternating transformer, and as we have seen in the discussion of Fig. 7, the rotating element also has generated in it an e. m. f. to which is due the currents in the short circuited winding. Neither will it do to call the rotating element armature and stationary element field, for just as the armature of a direct current machine may be stationary and the field rotate, so we may interchange the functions of the rotating and stationary elements of the induction motor.

By far the best course is to consider the induction motor as a transformer. In this case the element connected to the line is the primary, (rotating or stationary as the case may be), and the other element, the one in which currents are induced, is the secondary, (stationary or rotating). What has been heretofore designated as the field in Figs. 3, 4, 5 and 7, is now the stationary primary; the rotating element is the rotating secondary.

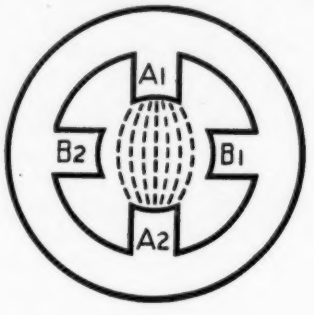


FIG. 3.

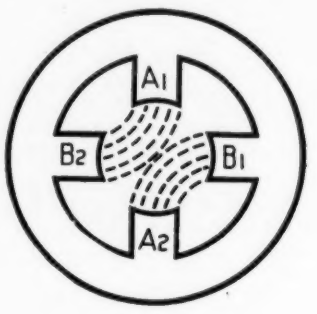


FIG. 4.

Let us look into the question of the induction motor as a transformer. In Fig. 7 first consider the rotating secondary, *A*, (formerly the armature), as held so that it cannot rotate. The rotating magnetic field will induce alternating currents in a short circuited winding. Now some of these closed circuits are directly opposite the poles *A1*, *A2*, and will affect these poles and the windings upon them just as the current induced in the secondary of a single-phase transformer influences the primary of the transformer. Similarly, some of the closed circuits are directly opposite the poles *B1* *B2*, and bear toward them the relation of secondaries. Some of the closed circuits are influenced by and exert influence on both sets of poles and have on each set of poles only part of the effect that they would have if opposite one or the other of the two sets. The result, however, so far as the electrical actions and reactions between the primary and secondary of the motor are concerned, is the same as though we considered the two pairs of poles, *A1* and *A2*, and *B1* and *B2*, as being single phase transformers, each having an equivalent short circuited secondary whose action on its primary is the same as that of the closed circuits of Fig. 7 on the pairs of poles *A1* *A2* and *B1* *B2*. If all the circuits of the short circuited secondary of Fig. 7 should be open so that no current could flow in them, it would be equivalent to opening the secondary circuits of the two transformers. The current which would then flow in each of the primaries of the transformers would be simply the current necessary to magnetize the transformer and to supply the power lost in the iron by hysteresis and eddy currents. If the circuits of the secondary of Fig. 7 should be short circuited again it would be equivalent to short circuiting the secondaries of the two transformers, in which case there would be drawn from the line by the primary of each transformer a current in addition to the magnetizing current, the additional current being that necessary to compensate for the current flowing in the secondary. If now the secondary of Fig. 7 be allowed to rotate, the electrical

conditions change from those having place when the motor is at rest. In the first place, as has already been pointed out, the e. m. fs. generated in the secondary, diminish, hence also the currents diminish; in the second place, the currents flowing into the secondary generate by virtue of the rotation of the conductors in which they flow, an e. m. f. in the primary. This e. m. f. generated in the primary corresponds to the counter e. m. f. of a direct current motor, and it is against it that the primary current does the mechanical work of the motor.

Comparing again the motor of Fig. 7 to two single phase transformers, the conditions when the motor is allowed to rotate are as though we had included in the secondary circuit of each trans-

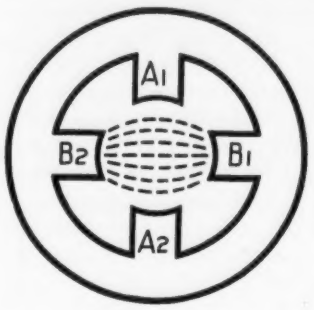


FIG. 5.

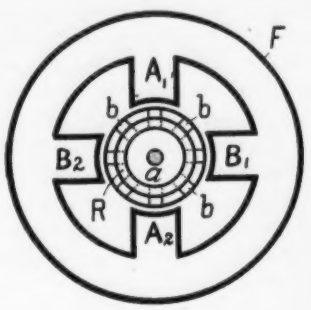


FIG. 7.

former a laminated motor series wound as for direct current, but run, of course, by the alternating current from the transformer. When the two series wound motors are held so they cannot rotate and the secondary circuits of the transformers are closed through them, we have a condition similar to that when current is thrown on the primary of Fig. 7, the secondary circuits being closed, but the secondary held so that it cannot rotate. When the two series motors are allowed to rotate, we have a condition similar to that when the secondary of Fig. 7 is allowed to revolve; that is, the currents in the secondaries of the two transformers are diminished and a counter e. m. f. is introduced through which mechanical work is done. The slip, or fall in speed, of the induction motor corresponds to the drop, or fall in voltage, of a static transformer.

So far we have treated the induction motor only as a constant speed motor (one which carries its load at constant or approximately constant speed), but it is possible to adapt it to variable speed work also. In the practice of the present day, it is usual to vary the speed of induction motors by either one of two methods. One of these is to vary the voltage impressed upon the primary of the motor; the other is to introduce resistance into the secondary circuits of the motor.

The first method is used in the case of a motor having a stationary primary and a rotating secondary of the so-called "squirrel cage" type, similar to that crudely illustrated in Fig. 7, and con-

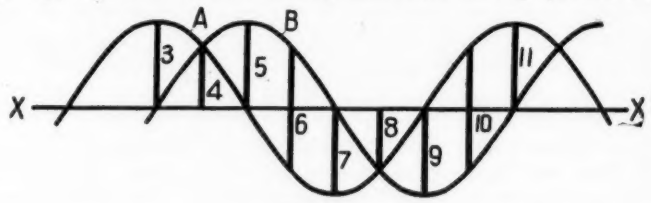


FIG. 6.

sisting of bars laid in longitudinal holes or slots in a cylinder of laminated iron, the bars being permanently short circuited at each end by metal rings having a resistance whose value is properly proportioned for the work which the motor is to do. Such a motor has, of course, no sliding contacts, and the construction of its secondary is such as to enable it to withstand a great deal of hard usage. The impressed primary voltage is varied by means of transformers, the voltage being raised or lowered until the proper speed has been attained by the motor.

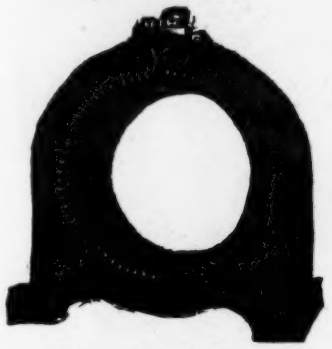
The second method is used in connection with a motor having slip rings on the rotating element. As previously mentioned the rotating element may be either primary or secondary. In the former case the slip rings serve to connect the primary windings with the line. In the latter case the slip rings furnish a means of introducing resistances into the secondary circuits. This resistance is in the form of a suitable rheostat, so that the amount of resistance included in the secondary circuits may be varied.

The theory of the speed variation attained by either of the meth

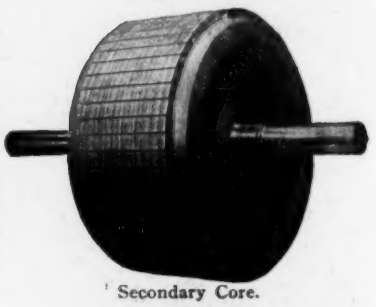
ods outlined will be clear on considering what has been previously discussed. Take the case of speed variation by varying the impressed primary e. m. f. Suppose the motor of Fig. 7 were carrying at a given voltage and at some speed less than its no-load speed a load of constant torque. Suppose now the voltage impressed upon the motor be increased. We know that in a transformer an increase of voltage means an increase of magnetization in the transformer core. This will be the case in the motor also. By increasing the primary voltage the strength of the rotating magnetic field will be increased. But a strengthening of the rotating field will cause an increase in the e. m. f. generated in the secondary and consequently an increase of the currents in the closed circuits of the

Cast Iron Housing.

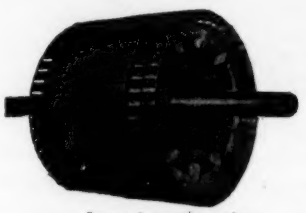
Primary Ready for Winding.



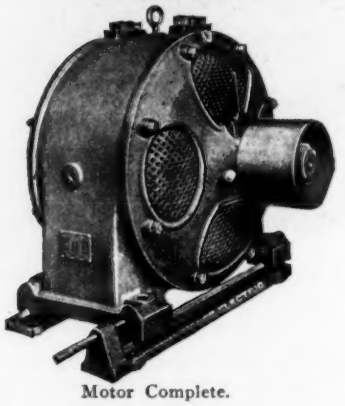
Primary Completely Wound.



Secondary Core.



Secondary Complete.



Motor Complete.

FIG. 8.—PARTS OF INDUCTION TYPE MOTOR, AND MOTOR COMPLETE.

secondary. Now the increased secondary currents mean an increased torque, so that, since the torque of a load is constant, the motor will speed up, thus diminishing its slip, and consequently, the strength of the currents in the secondary. The slip will continue to diminish, that is, the speed will continue to increase, until the secondary currents fall back to the values which they had before the primary e. m. f. was changed. That is, they will fall back to a value just sufficient to produce the torque necessary for carrying the load. If, on the contrary, the primary e. m. f. instead of being increased, were to be diminished, the speed of the motor would fall. For a given load there will be a speed corresponding to each voltage impressed upon the motor, the speed increasing or diminishing when the voltage increases or diminishes, but no matter how high the voltage be raised, the speed can never quite equal that of the rotating field, although, as has been previously explained, it may approach it very nearly. The speed of the rotating field is the limiting speed of the motor to which the motor speed may be made to approach closely either by greatly in-

creasing the motor voltage with a given load or by taking the load upon the motor very light.

When resistance is introduced into the secondary of a motor carrying a load of constant torque, the speed diminishes because the introduction of the resistance decreases the secondary current. The speed will fall until the slip, and therefore the secondary e. m. f. increases to such a point that the value of the secondary currents is the same as before the resistance was cut in. With a given load, the greater the resistance the less the speed, and the less the resistance the greater the speed up to the no-load speed of the motor.

The methods described for controlling variable speed induction motors is also used in starting constant speed motors. Such a method of starting not only avoids an excessive torque at the instant of starting, but keeps down the starting current, accomplishing the same result as is attained by the use of a starting rheostat in the armature circuit of a direct current shunt motor. Indeed, the behavior of an induction motor whose speed is varied by means of a rheostat in the secondary is identical with that of a direct current motor whose field is kept constant and whose speed is varied by means of a rheostat in the armature circuit, while the behavior of an induction motor whose speed is controlled by a variation of voltage is identical with that of a shunt wound direct current motor when the voltage delivered to both armature and field is varied at the generator. This latter statement should not be confused with the condition existing when the field of a direct current motor is kept constant and the voltage impressed on its armature is varied at the generator.

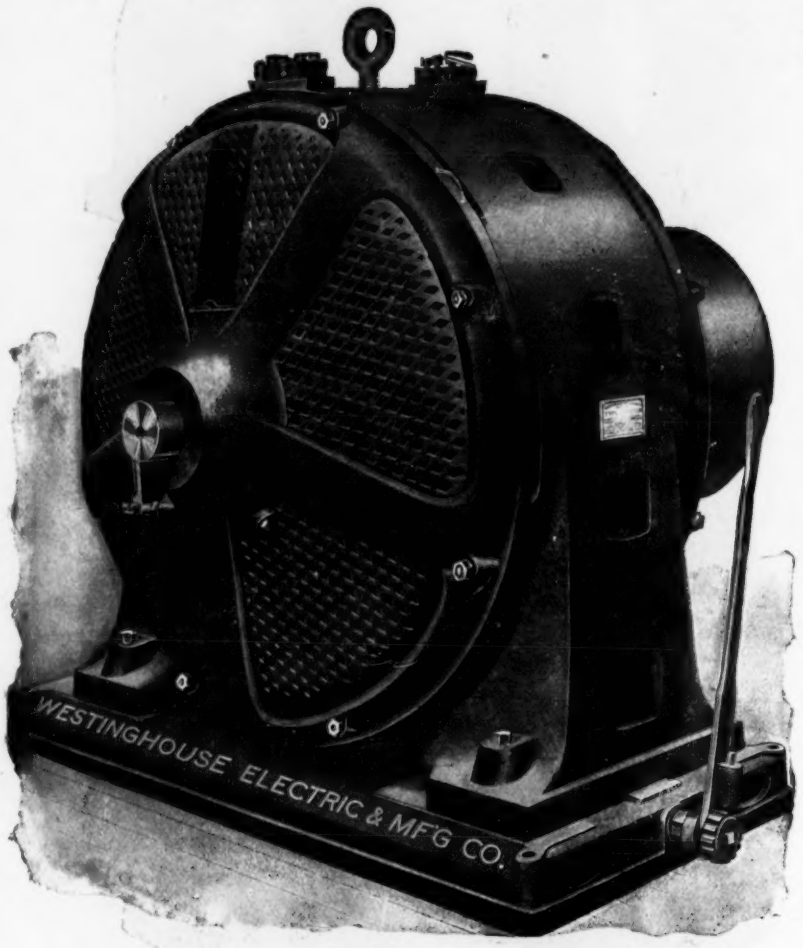


FIG. 9.—150-HP. INDUCTION MOTOR.

The type of polyphase induction motor most generally used today is not of the design depicted in Fig. 7. The primary has no salient poles like those of Fig. 7. Both primary and secondary have slotted cores of laminated iron. The primary winding consists of overlapping coils laid in the slots and forming a "distributed winding," similar to that of a direct current armature. The primary still has poles just as truly as Fig. 7 has them, and the number of these poles in each circuit determines the speed of the rotating field as previously explained in connection with Fig. 3, but the poles are due to the grouping of the primary coils and not to a polar projection as in Fig. 7. Also the coils forming the windings of the two circuits in case of a two-phase motor or of the three circuits in the case of a three-phase motor overlap, but the winding of each circuit is arranged with reference to the poles of that circuit. All the circuits of the primary are, of course, wound so as to have the same number of poles. The secondary winding depends upon the type of motor;—whether it is one having no slip rings and started by supplying it with a reduced voltage, or whether it has slip rings and is started by introducing resistance in its secondary. In the latter case the secondary windings are very similar to those of the primary, in the former case, the squirrel cage winding is used.

Fig. 8 shows the two elements of a motor having a stationary primary and a rotating squirrel cage secondary. This figure shows the slotted cores of the primary and secondary, the overlapping coils of the primary and the bar wound short-circuited secondary.

The current taken by an induction motor is comparable to that of a transformer having a comparatively large magnetizing current, for the induction motor is a transformer with an air gap in its magnetic circuit. At no load the motor takes current sufficient to magnetize the iron and air gap and this no-load current bears a greater proportion to the full load current than in the case of most static transformers, because of the fact that the static transformer generally has a closed magnetic circuit. The no-load current taken by the motor is not, however, all of it, work current. That is to say, the product of the no-load current by the voltage at which it is delivered does not represent the power supplied to the motor. In a good motor only a small per cent. of this product, or "apparent power," is true power, and this small percentage of the "apparent power" represents the no-load loss to the motor. The percentage which the true power supplied to the motor at a given load is of the apparent power supplied, that is, the ratio of the true power to the apparent power, is called the "power factor." The value of the power factor is different for each load put upon the motor, for as the motor is loaded the current supplied to it increases, though the increase is not in proportion to the load. The increase of the current is less rapid than the increase of load and in consequence as the load upon the motor increases the apparent power supplied to it becomes more and more nearly equal to that of the true power, that is, the power factor of the motor increases. This increase of power factor continues until it reaches a maximum, generally at a point somewhere near the rated full load capacity of the motor.

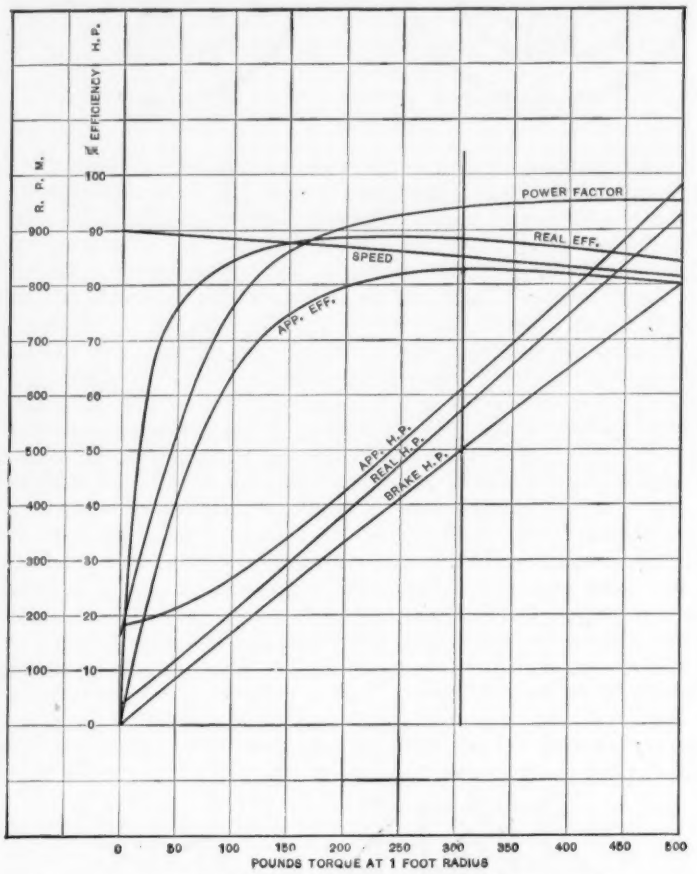


FIG. 10.—PERFORMANCE CURVES OF 50-HP INDUCTION MOTOR.

Fig. 10 shows the performance curves of a 50-hp constant speed polyphase induction motor built for 60 cycles. This is a motor wound for eight poles to each circuit so that the speed of the rotating field is 900 r. p. m. It is of the type having no collector rings and shown in Fig. 9. The curves show the brake output of the motor, the electrical input, both real and apparent; the real and apparent efficiencies, the power factor and the slip. By the apparent efficiency is meant the ratio of the output of the motor to the apparent power (the volt-amperes) which it receives. An inspection of the curves will show the way in which the power factor increases as the load increases, and the high power factor reached so soon as the motor load is of any considerable amount.

Although throughout this paper a two-phase induction motor has been considered, the conclusions arrived at apply equally well to a three-phase motor, as the principles involved in two-phase and three-phase motors are identical. The two-phase motor was chosen as being simpler of explanation.

The advantages of the polyphase induction motor are easily apparent to any one who has handled this class of machinery. Its development has made possible a motor self-starting under load and without moving contacts. This means a motor free from commutator troubles, which in turn means a motor which will stand an amount of overloading and rough usage that would soon put a direct current motor out of service. It means a motor which can be installed under conditions where no other type of motor could survive, and which will require an amount of attention as small as is possible in a piece of moving apparatus. It is the nearest approach in a piece of moving apparatus to that nearly perfect electrical device, the static transformer. Its crowning advantage is that with all the advantages mentioned it is an alternating current motor; a motor which in connection with static transformers can be adapted to any voltage, thus making possible the safe and successful distribution of light and power from one system at a high voltage.

At the conclusion of the reading of the paper, Mr. Mershon added that the question of power factor is not very complex if it is simply considered as a ratio between the true powers supplied to any piece of apparatus and the apparent power. The analogy between the static transformer and the induction motor is stated to be a very complete one. We have magnetic induction in one corresponding to magnetic action in the other, and the action and reaction between the primary and secondary are the same and the drop is also the same.

In answer to a question as to the limits within which resistance may be introduced in the secondary circuit of an induction motor to control speed, Mr. Mershon said that wherever a shunt motor can be used having the speed regulated by the introduction of resistance into the circuit, an induction motor can also be used. The losses in both cases are exactly the same, which means that whenever the motor is running below normal, there is a loss in the series rheostat which will be greater the further the speed of the motor is from its normal speed. In this manner the speed of an induction motor may be varied from zero to full speed.

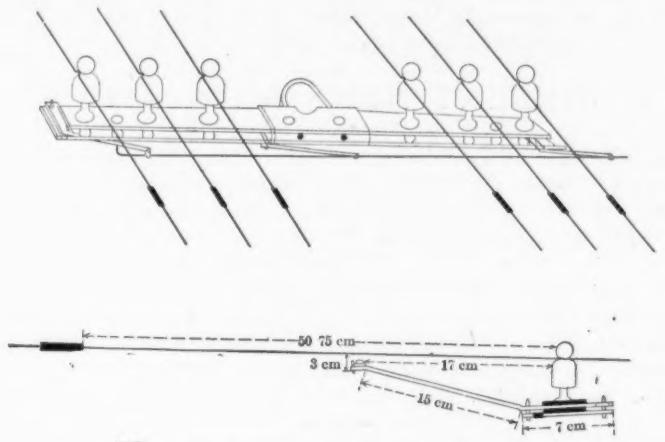
In reply to a question as to the efficiency of a 5-hp induction motor running at half speed, Mr. Mershon said it would be exactly the same as a shunt motor of the same power controlled by a rheostat, that is, half of the voltage being consumed in the armature circuit and half in the rheostat and the same current going through both, one-half the power would be lost in the rheostat, which would result in less than 50 per cent. efficiency. Both the induction motor and the direct current motor will take from the circuit the same amount of power no matter what the speed of the motor is, even if it is standing still. The relative loss in the rheostat can thus be figured out, it being the relation between the full load speed of the motor and the speed at which the motor is running.

In reply to a question, it was stated that a very great speed variation cannot be obtained with a single-phase motor, and to vary the speed of such a motor is not satisfactory. In answer to a query as to the effect of introducing an inductive resistance to decrease the speed of polyphase induction motors, Mr. Mershon said that there is no advantage in introducing inductive instead of ohmic resistance, as the loss of energy would be the same in either case.

In reply to a query it was stated that the polyphase motor behaves under a sudden change of load exactly the same way as a direct-current motor with the advantage that there is no commutator to damage. A well-designed motor will carry for a little while an overload of from 100 to 125 per cent. For intermittent service, such as a traveling crane, the speed of the polyphase motor is generally controlled by regulating the voltage rather than by means of a rheostat. If regulated by a rheostat there must be wires in the secondary and the primary, but with the first-mentioned method, only wires in the primary are needed. In this case a controller is used in connection with the transformer, the controller being similar to that kind used in direct-current work; in fact, the man operating it will not know the difference.

Protection of Telephone Wires Against High-Tension Currents.

The officials of the German Postal Telegraph Department have made a large number of experiments with a view to finding a reliable means of protecting telephone wires against high-tension currents in cases of breaks. It was proposed to surround each telephone wire at each insulator in dangerous localities by a loop of wire connected with the ground. Where there are a number of wires a guard wire, also grounded, is substituted for the single loop, and affords protection to all the wires on a cross-arm. In many of the experiments made by Mr. Canter, of the department, bronze wires were used, but these exhibited a tendency to coil up and either fail to act or act slowly. To avoid this action he placed around each wire, at a distance of 19½ inches from the insulator, a piece of lead weighing about one pound. He also determined the most favorable distances between points of support of the guard wire, so that in case a telephone wire should break it would always come in contact with the protective device and prevent an accidental ground connection under normal conditions. The device is illustrated in the accompanying cut, which shows the manner of supporting a guard wire on a cross-arm carrying six wires. The guard wire is supported by three iron braces bolted to the cross-arm. To get the proper results, the guard wire should not be placed nearer than 6½ inches from the insulator and should be 1¼ inches beneath them. The ends of the guard wire are bent upward, so that a broken telephone wire cannot slide off sideways. It is stated that this system will be employed to protect the fire-alarm wires in Frankfurt am Ader, where it has been in successful use on other circuits since July last.



TELEPHONE WIRE PROTECTORS.

The Wehnelt Interrupter.

In a paper presented to the French Academie des Sciences, M. Rothe described some curious phenomena in connection with the Wehnelt Interrupter when supplied from a line of constant e. m. f. with a variable resistance in circuit. The two electrodes of an interrupter were connected with 113-volt street mains with a variable liquid resistance in circuit, the latter consisting of a weak solution of sulphate of copper in which were plunged two copper plates, one of which was movable. The anode of the interrupter consisted of a platinum wire .02 inch in diameter and ¾ inch long.

Under these conditions, beginning with the strongest resistance, the intensity of the current was small but constant for a given resistance. As the resistance was diminished the current increased conformably with ohm's law, up to 11½ amperes, and then it sud-

denly fell to 2½ amperes. At this point the ammeter indicated variations of current, and—which is especially remarkable—the resistance can be considerably augmented or diminished without modifying the régime. It can thus be said that there exists for each interrupter and for a given e. m. f. a limit of resistance such that for all smaller resistances the variable régime is alone possible. For all higher resistances one can have either a variable or a constant régime according to the way in which the current was established.

At the moment when the change of régime occurs a sheath of gas forms about the anode. The upper part of this sheath swells into a bubble. Each time the bubble forms the sheath contracts, and on the contrary, each time that the bubble disappears the sheath swells. The variations in the sheath of gas produce variations in the intensity of the current, but which are too feeble and too slow to cause the platinum anode to act as an interrupter of current. During this régime an inductance can be introduced in circuit without making any change. If, however, a self-inductance is introduced into the circuit before it is closed, the mean intensity of the current can attain a value as high as 30 amperes. In the latter case the interrupter exerts a remarkable influence on incandescent lamps installed on the circuit with which it is connected. Not only in the physical laboratory in which the interrupter was placed, but also in neighboring laboratories the lamps glowed with a greatly increased brilliancy when the interrupter was working.

CURRENT NEWS AND NOTES.

CANDIDATES FOR THE NOBEL PRIZE.—Among the names proposed to the Swedish Academy of Sciences at Stockholm for award of Nobel prizes for scientific achievement are those of Prof. Röntgen and Signor Marconi.

MANUFACTURERS' TRIP TO PARIS.—The National Association of Manufacturers has arranged with a tourist company for a trip to the Paris Exposition, to sail probably June 13 on the St. Louis. The party will spend nineteen days at the exposition. The cost is $400 per head.

A. I. E. E. LIBRARY.—The Council of the American Institute of Electrical Engineers has appropriated $500 for library purposes, proposed to the Swedish Academy of Sciences at Stockholm for binding several hundred volumes of electrical periodicals which have accumulated since the birth of the Institute.

UNION LABOR AND ENCLOSED ARC LAMPS.—The Detroit *Free Press* reports that organized labor has announced that the enclosed arc lamps used on the Detroit municipal system must be replaced by the old-type open arc lamp, thereby giving employment to ten more men and putting an additional $7000 per year in circulation.

THE ST. ANTHONY FALLS WATER POWER COMPANY, of Minneapolis, Minn., which recently developed 10,000-hp by building a $1,000,000 dam and electrical power house below St. Anthony Falls, has won the case brought by owners of the river rights on the west side and just below the new dam. The trial was a long and hard fought one, and lasted a month.

CANADIAN WATER POWER DEVELOPMENT.—A scheme is under way for the development of the water power at Tetreauville in Quebec Province, on the north side of the Ottawa River and about two miles from the City of Ottawa. The property along the shore of the river at that point has just been acquired by a syndicate of Ottawa capitalists, which intends forming a company to be styled the Chaudiere Electric Company.

FRENCH CABLE LINES.—The details of the bill to lay purely French cables between the French colonies have been made public. The bill provides for four new lines. One is to run from Oran, Algeria, touching Tangier and Teneriffe, to St. Louis, Senegambia. The second cable is to run from Uahue, Tonquin, to a point north of Hong Kong. A third cable is to connect Tamatave, Madagascar, with Reunion Island, one of the Mascarine group. The fourth line will be between Benin, in Upper Guinea, and the French Congo possessions.

AN ELECTRIC WATER FILTER.—A patent issued Jan. 2 to W. L. Teter and John A. Heany describes an electrical attachment to a water filter, having for its object the purification and sterilization of the water passing through it. In passing from one compartment of the filter to another, the water is caused to flow through a tube; in this tube and separated a considerable distance are two electrodes which are connected to a source of electricity. It is claimed the water in passing between the electrodes will be partially decomposed with the formation of hydrogen, oxygen and ozone!

ENGINEERING EDUCATION.—In a lecture at the University of Wisconsin, Mr. B. A. Behrend illustrated the advantages of technical education by a statement of the conditions which until lately existed in England. In that country there were no schools for systematic technical training, the experience in shop-work being considered sufficient. As a result Germans of technical education became the professional heads of most English establishments where higher technical knowledge conduced to commercial success. In referring to the education of engineers, Mr. Behrend dwelt upon the desirability that they also possess a thorough general education.

MANUFACTURE OF ALCOHOL FROM ACETYLENE.—A recent consular report gives the opinions of several scientists as to the practicability of manufacturing alcohol from acetylene. One of the German scientific authorities, to whom application was made for information, said that the industrial production of alcohol from acetylene is not practical on account of the expense, though the process itself is a simple chemical one. Another authority corroborates this, but says that there is a possibility of producing aldehyde, etc., cheaply, but this fact is of no practical importance. A calculation by a French authority is given as to the cost of producing alcohol from acetylene, the total being $10.27 per hectoliter. The present price of alcohol is about $5.79 a hectoliter, and the cost for producing it from acetylene would not equal this should the price of calcic carbide be halved.

ELECTRICAL RESISTANCE MATERIAL.—In a patent issued January 30 to J. T. Bachman and A. Vogt, of Vienna, Austria, a process for manufacturing electrical resistance material is described, which consists in forming a plastic mass or mixture of a conductor and a non-conductor of currents and of a metallic compound convertible into conductive metal, the mass being then worked with water into a paste or dough, from which by molding, casting or otherwise, the shape is produced which it is desired that the resistance body should possess. The shape after being dried is then embedded in pulverized carbon and heated to a high temperature. The non-conductor may be any artificial stone, clay, refractory metallic oxide, or metallic substance which in the process of manufacturing resistance material, does not suffer change. The conductor may be carbon in one of its forms, or a conductive metal, or any metallic compound which in the process of manufacture of the resistance material is converted into conductive metal.

MEETING TO URGE GOOD ROADS.—The Automobile Club held a meeting at the Waldorf-Astoria on February 3 for the purpose of urging upon the legislature of New York the importance of appropriating a liberal amount under the provisions of the Higbee-Armstrong bill for improving the highways of the state. Addresses were made by Gen. Roy Stone, E. G. Harrison of the office of Road Inquiry of the Department of Agriculture at Washington; Edward A. Bond, Chief Engineer of the State of New York; Henry L. Budd, Commissioner of Roads of New Jersey, and Prof. T. C. Mendenhall, of the Massachusetts Highway Commission. Since the good roads movement was begun the state and counties of New Jersey have spent $2,147,478 in improving their highways, and up to Dec. 16 last have completed 439½ miles of road. The state and counties of Massachusetts during the same period expended $2,637,300, and built more than 250 miles of road, which, according to Prof. Mendenhall, is as perfect as any of the highways of Europe. The Higbee-Armstrong bill became a law in this state a little over two years ago, and there has been an annual appropriation of $50,000 as state aid for the improvement of highways. New York thus far is far behind either Massachusetts or New Jersey, and efforts will be made to show that if the commerce is to be retained and merchandise brought satisfactorily to the railroads and canals upon which so much public money is being lavished the highways must be improved.

NATIONAL ELECTRIC LIGHT ASSOCIATION, through Secretary Porter, announces that the dates decided upon for the twenty-third convention are May 22, 23 and 24, in Chicago.

DOCTORS OF ENGINEERING.—The German emperor has recently authorized the granting of the degree of "Doctor" to engineers. The condition is imposed, however, that the title must be written in Latin to distinguish it from the older degree to which it corresponds.

THE MINNESOTA STATE BOARD OF ELECTRICITY has made its first report to the governor, from its beginning July 18 to Jan. 6. It has registered 514 electricians by virtue of their standing in the trade when the law began, and 23 by examination. It has given master's certificates to 30, journeymen's to 219 and specials to 288, these last men that were working at the trade but probably unable to pass examination.

COMMERCIAL CONDENSERS.—In an editorial in the issue of January 20 the statement was made that reliable condensers of large size for use on alternating current circuits were not to be obtained on the market. We learn that this statement is in error, the Stanley Electric Manufacturing Company having for a number of years manufactured condensers not only of large capacity, but of commercial reliability, as proved by lengthy use.

MR. W. J. JOHNSTON IN THE PHILIPPINES.—Mr. W. J. Johnston has arrived at Hong Kong after an extended visit to the Philippines. Having procured from General Otis a pass to the firing line, he was enabled to witness the capture of Santa Rosa on New Year's Day. Subsequently during a three weeks' cruise in the archipelago, Mr. Johnston visited Iloilo, Zamboango, Parang-Parang, Pollak, Davao and Jolo, and met the Sultan of Mindanao.

EARNINGS ONE DIME.—The Mississippi Valley Telephone Company's return to the state treasurer of Minnesota shows that the company's gross earnings in 1899 were 10 cents paid by a soldier of the Forty-fifth Regiment, who refused free use of the wires. As the company's expenditures were about $300,000, and it is desired to preserve the dime as a souvenir, permission is requested to let the observance of the forms of the law go over until next year.

MANUFACTURE OF AMERICAN CABLES.—At Washington on Feb. 6 the House Committee on Commerce heard representatives of American cable concerns in advocacy of a provision in the Pacific cable bill that the cables be of American manufacture. Messrs. Satterlee, of New York, and Marsh and Hughes, of Pittsburg, in behalf of large cable interests, stated that the facilities in this country were ample for turning out all the cable required for the Pacific project.

NEW PATENT AND TRADE-MARK LAWS.—The commission appointed to revise and amend the statutes relating to patents, trademarks and trade and commercial names has practically completed its report, which will soon be submitted to Congress. It will recommend legislation to carry out treaties with foreign countries in regard to the patents, as it has been decided that the treaties are not self-executory in this respect. Legislation looking to a better protection of trade-marks will also be recommended.

MAXIMUM CURRENT INDICATOR.—In a patent granted Jan. 30 to Crawford R. Brown, an ampere indicator is described, by means of which the maximum electrical current used by consumers may be determined during any period. When a current larger than that theretofore registered enters the instrument, a solenoid actuates an arm which in turn makes a contact whereby a clock escapement is released which permits the registering indicator arm to be carried along the solenoid mechanism as long as the contact is maintained.

PARIS EXHIBITS.—The United States auxiliary cruiser Prairie has sailed from the Brooklyn Navy Yard for Baltimore, where she will take on board the rest of her cargo of government exhibits for the Paris Exposition. It is expected that she will sail from Baltimore for Havre the end of this week. This will be the last cargo of government exhibits which will be sent on the Prairie. Her cargo includes the exhibit for the Department of Machinery and Electricity, and that of the Department of Transportation, which embraces models of all kinds of engines and cars.

BUDAPEST-LONDON TELEGRAPH.—United States Consul Chester, at Budapest, reports to the State Department that a direct telegraph line has been opened from Budapest to London which is expected to be of immense value to the Hungarian grain dealers in their competition with the United States dealers for the Liverpool market. Heretofore, owing to the indirect means of communication, it was impossible to secure orders from London or from Liverpool, where the price of wheat was set, on the same day, and Liverpool quotations were also received too late for use on the same day, all of which gave a heavy advantage to the New York dealers.

ELECTRIC LIGHTING IN DUBLIN.—A recent consular report gives an account of a plan for extending the electric lighting system of Dublin, Ireland, which has been approved by the municipal council of the city. The plans contemplate the expenditure of $1,272,000, of which $515,000 will be for the feeding and distributing system, $202,000 for arc lighting, $480,000 for the generating plant and $75,000 for meters and house connections. Among the items for the generating plant are $179,500 for the engine room installation and $58,350 for the boiler room plant. Five hundred lamp posts at $110 each will be installed. The plant will have a capacity for 100,000 8-cp lamps.

ETHERIC TELEGRAPHY.—It is said that the British have shipped for the purposes of the Transvaal war ten balloons to Cape Colony, and as many to Natal, all furnished with wireless telegraph apparatus. The balloons are comparatively small, and can accommodate but one man. The distance to which the apparatus has been successfully used in this manner is about forty miles. Capt. Kennedy, who has charge of this work, sailed from Southampton for Durban at the end of October. The personnel of the two balloon sections sent with the army corps comprised sixty-eight officers and men and twenty horses, the material being transported on one balloon wagon, one material wagon and four gas wagons.

ALTERNATING CURRENT WATTMETER.—In a patent granted Jan. 30 to Carl O. F. Schrottke, of Berlin, Germany, an alternating current wattmeter is described, primarily adapted for use in connection with circuits conveying currents of heavy voltage. In series with one of the mains of the circuit is the primary of a transformer; the secondary coil of this transformer is connected with the current coil of the wattmeter, the pressure coil being in shunt across the line. In shunt with the first mentioned or current coil is a non-inductive resistance which, of course, is also in shunt with the secondary coil of the transformer. By this means the secondary current is divided into two components, one in the non-inductive resistance and the other in the current coil of the instrument, which latter is displaced exactly 120 degrees from the primary pressure.

PROF. MORSE'S HOUSE.—With the destruction of the fine old brownstone mansion, 7 West Twenty-second Street, to make room for a modern building, one of New York's most famous houses disappears. It was for many years the city residence of Prof. S. F. B. Morse, and there he died. A marble tablet bearing a brief inscription, set in the wall of the house, commemorated the fact of his residence. As soon as the ground is cleared a twelve-story steel frame office building will be erected. It is proposed that this structure shall bear a suitable tablet. Prof. Morse's fame is so indissolubly connected with the electric telegraph that the fact that he was also one of America's most prominent painters is often lost sight of. In 1829 he founded the New York Training Academy, which became the National Academy of Design, of which he was the first president. The great inventor died in New York on April 2, 1872.

AN ELECTRIC GUN.—The newspaper press has recently devoted some space to an account of an electric gun invented by L. S. Gardner, of New Orleans, who is described as a "scientist, inventor and electrician." The gun consists of a cylinder open at both ends and surrounded by a sectional solenoidal coil. By means of a commutating switch, coils in front of the projectile are cut in, and those in the rear cut out, as the projectile moves along the cylinder. The inventor believes that by this means an enormous velocity may be attained. Had he, however, sought for data in a book on ordnance as to the energy required to send, say, a six-inch shot on its

flight, he might have been less sanguine concerning the future of the electric gun. A six-inch shot from a modern gun in less than .02 of a second has stored in it over five million foot pounds of energy, or at the rate of more than a half-million horse-power. Considering the inefficiency of the method proposed for imparting energy, electrical apparatus of some million horse-power of capacity would be required to give a shot of the size mentioned the velocity it has imparted to it by explosive means in the usual manner.

LETTERS TO THE EDITORS.

The Presidency of the A. I. E. E.

To the Editors of Electrical World and Engineer:

Sirs:—As the time has arrived for nominating officers for the ensuing year in the American Institute of Electrical Engineers, and as the nominations usually control the election, and as your columns offer a ready means of reaching the members of the Institute, it is in order here to say a few words about the candidate for the presidency. The name of Mr. Carl Hering is suggested for that candidacy, and seems to meet general approval. I wish to add my most hearty endorsement of Mr. Hering's name, as he has been in the past a most active worker in the interests of the Institute, and has already represented the Institute abroad in a highly creditable manner. His election will provide the Institute with a most efficient representative at the coming International Electrical Congress next summer, and as presiding officer at the Paris meeting of the Institute his knowledge of the French language, and his wide personal acquaintance in European electrical circles are additional qualifications.

TOWNSEND WOLCOTT

NEW YORK, N. Y.

To the Editors of Electrical World and Engineer:

Sirs:—Permit me to propose through the columns of your esteemed journal, Mr. Charles S. Bradley as candidate for the presidency of the American Institute of Electrical Engineers. I have to support my proposition by a brief review of Mr. Bradley's engineering record. I am aware that I run the risk of offending the code of good form; for sincere appreciation of a man's good work may be looked upon as honest enthusiasm or mere hollow gush, depending on circumstances. It is extremely difficult to speak enthusiastically of the work of a living man and avoid the appearance of being a flatterer. I am prepared to pay the penalty of this appearance.

Mr. Bradley was always connected with big things in electrical engineering. He was the engineer of the Edison Illuminating Company in 1881. Electric lighting was then a huge experiment. It proved a huge success, thanks in a great measure to Mr. Bradley's inventive resources.

The Edison Illuminating Company was then too small for two men like Edison and Bradley. Mr. Bradley transferred his activity to a very modest little laboratory of his own in one of the most secluded little alleys in Yonkers. This laboratory was the birthplace of some of the foremost electrical inventions in electrical engineering. I shall mention a few of them only.

The electrical reduction of aluminum. A patent on this invention was granted to Mr. Bradley in 1891. The process employed by the Pittsburg Reduction Company, at Niagara, and by many European companies is based on this patent. *The method of multipolar winding,* now so generally employed in the construction of continuous current machinery, was first worked out by Mr. Bradley. He constructed the first multipolar machine in this country in 1887. It was tested by Prof. Geyer, of Stevens Institute, and by the Edison Electrical Works, at Schenectady, where it created a profound sensation. *The generation and the method of combining* polyphase electromotive forces was first developed by Mr. Bradley in 1887. The famous transmission experiment at Frankfurt in 1891 brought Mr. Bradley's name in strong prominence, alongside of the names of Ferraris, Tesla, Wenstrom and Dobvowolsky. Even since that time he has been known in Europe even better than in his own country.

The first *rotary converter* was built by Mr. Bradley in 1888, and secured for him a broad patent on this invention, which may be regarded as the very backbone of electrical transmission of power.

It is not necessary to go any further into the long list of Mr. Bradley's epoch-making inventions. I have said enough to prove the appropriateness of my proposition.

M. I. PUPIN.

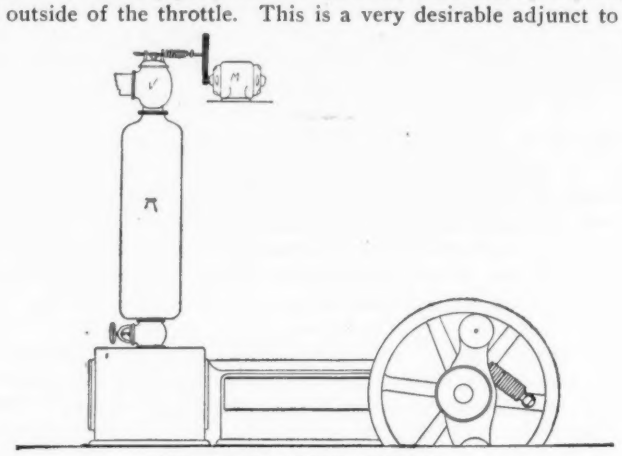
NEW YORK, N. Y.

Parallel Operation of Direct Coupled Alternators.

To the Editors of Electrical World and Engineer:

Sirs:—In the parallel operation of direct-coupled alternators, the power developed per stroke by an engine is dependent, if we disregard certain unimportant factors, upon the initial pressure of the steam and the point of cut-off. If the point of cut-off is set by a centrifugal governor, it becomes a function of the speed of rotation. It is necessary in putting alternators into parallel, in dividing the work between two alternators running together, or in taking an alternator out of parallel, that the power developed by the engine shall be variable without change of speed of the engine. It follows that either the point of cut-off must be taken out of the control of the centrifugal governor, or the initial pressure of the steam must be changed. The more recent devices for paralleling of alternators depend on variation of cut-off. The older parctice of altering the initial pressure by means of the throttle becomes inadvisable with large engines and particularly with those having several successive cylinders.

I desire to point out a method of obtaining satisfactory results which does not involve tampering with the adjustment of the centrifugal governor and yet is free from the troubles that affect the manipulation of the throttle. Many steam engines have an enlargement of the steam pipe (termed a receiver) immediately adjacent to and outside of the throttle. This is a very desirable adjunct to any



METHOD OF ENGINE CONTROL.

engine carrying a variable load or controlled by automatic cut-off. It permits a reduction of the diameter of steam pipe because it allows an approximately uniform rate of flow of the steam; and in practice the steam pipe may be so much reduced by the use of a sufficiently large receiver that the saving in first cost of pipe, pipe covering and valves will more than pay for the receiver.

If there be fitted in the steam pipe next to and outside of the receiver a proper reducing valve to be used at times when control of the engine speed is necessary for the purpose of varying the pressure in the receiver (the general arrangement being as shown in sketch enclosed) sufficient control of the engine speed for purposes of parallel running may be obtained. It being essential that the two engines shall run at the same speed, it follows that the point of cut-off on the two engines must remain the same, yet the engine supplied at reduced steam pressure may only do enough work to supply its friction losses; or it may, by varying the tension of the spring of the reducing valve by the motor indicated, do sufficient work to divide the total load with the other engine. Reducing valves are to be had which give a full port opening, and as in practice the valves would only be in service for putting engines into parallel or taking them out, the wear of valve seats and discs would be a trifling item of expense. The motor, of course, would be controlled from the switchboard.

DETROIT, MICH. ALEX DOW.

Carbon Batteries.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of July 1, 1899, I called attention to some experiments with short-circuited "carbon batteries," constructed ac-

cording to the description of Dr. Tommasi, as given in the London *Electrical Review* of May 12, and in the ELECTRICAL WORLD AND ENGINEER Digest, June 3, 1899. In my communication the following statement was made:

"The Tommasi batteries, after standing indefinitely on short circuit, did not produce a particle of carbon monoxide, carbon dioxide, hydrogen, metallic lead or metallic copper. There was no evidence of any chemical change whatever."

In a subsequent letter, published in these columns Aug. 12, 1899, I described similar experiments with a short-circuited battery, constructed of carbon, platinized platinum and a solution of ferric chloride acidulated with hydrochloric acid, performed for the purpose of verifying with a commercial quality of carbon the oxidation obtained by Mr. Willard E. Case by the action of such a solution on the residue of burnt sugar, and described by him in a Royal Society paper. My communication closed with the following statement:

"The apparatus has been standing in this condition [short-circuited] 11 days and no trace of CO_2 or other gas has formed. Nor is there any indication of any chemical action whatever."

I wish now to merely record the fact that these Tommasi and Case batteries have been on continuous short circuit an additional six months, and there is still no indication of any chemical change in either the Case or the Tommasi type. Not the slightest trace of carbon dioxide or any other gas has been formed. I thought it important to publish this additional data, in order that it may be available for those who, in the future, may desire to calculate the possible output in electrical energy, of "carbon-consuming" batteries of these particular types.

C. J. REED.

PHILADELPHIA, PA.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCE.

Motor Designs.—POOLE.—The conclusion of the design of the 1-hp four-pole motor commenced in the previous issue of that journal.—*Amer. Elec.*, February.

LIGHTS AND LIGHTING.

Twin-Carbon Arc Lamp.—MATHIESSEN.—An illustrated description of a German type. It is a combination of two independent regulating devices which are attached to a common base-plate. The regulating mechanism belongs to the well-known type in which a magnet provided with a hinged armature actuates a regulating clockwork. The details of the mechanism are described and illustrated. The advantage of this type of lamp is that it may be connected singly across a 110-volt circuit or in pairs across a 220-volt circuit. The general tendency to increase the pressure of current supplied to the consumer is thus facilitated, as not every consumer can use four to six of the ordinary type of lamp. The disadvantages are an increase in working cost, as two pairs of carbons are used instead of one, and the fact that the intensity of light given by two arcs is not as great as that of one arc for equal amounts of energy. The twin-carbon arc lamp is claimed to be superior to the enclosed, as regards intensity of light. (The translation in the Lond. *Elec. Eng.* is incorrect).—*Elek. Anz.*, Jan. 11; translated in Lond. *Elec. Eng.*, Jan. 19.

Lighting from Primary Batteries.—WOODFORD.—An article telling how to arrange the plant for a private house using 14-cp 14-volt lamps, which the writer states can be obtained with an efficiency of one watt per candle. These are supplied from gravity batteries, the regulation being obtained by means of storage cells. The latter are eight in number, six being in the main battery and two more arranged as end cells connected to a regulator which can be adjusted to give the lamps the proper voltage as the storage battery charge falls off during the evening. The primary batteries are connected directly in parallel with the storage cells, charging them throughout the day according to their exhaust during the previous evening, the two types of battery mutually adjusting themselves. The figures of cost and maintenance are worked out showing very favorable figures, which of course are largely due to the assumed efficiency of the lamps.—*Amer. Elec.*, February.

REFERENCE.

Illuminating Globes.—WILLIAMSON and KLINCK.—An illustrated Franklin Institute paper on a photometric comparison of globes. The method of testing is described and the results of the tests of different globes are given in diagrams, showing that a globe or reflector should be designed with due regard to the service expected of it.—*Jour. Frank Inst.*, January.

POWER.

Electric Motors for Hoisting Apparatus.—NIETHAMMER.—The first part of a very long, illustrated article. After summing up the advantages of the use of electric motors for this purpose, he discusses the acceleration, the speed and the current consumption by means of diagrams. It appears that high speed of hauling is economical. The success of an electric installation for hoisting purposes is said to depend largely upon the condition and the design of the generating plant: if accumulators can be used, relatively small efforts are required from the engines. For this reason and on account of the easy regulation the continuous-current system is preferred to the three-phase system. For a continuous-current system in a smaller installation compound or overcompound machines are preferable, while in a larger network with accumulators, shunt dynamos are best. He discusses briefly some special connections, the question of compounding three-phase dynamos, and protection by automatic cut-outs, which he thinks preferable to fuses. Of the different continuous-current dynamos the series motor is the best for all lifting apparatus, in which there never can be no load at all. The shunt motor is to be recommended only for such apparatus where for any load a constant number of revolutions is required, and for such installations in which a case of no load can occur by balancing one load against another. The three-phase motor is in most respects as good as the continuous-current motor, or even better, especially mechanically. Single-phase alternating-current motors should not be used, if possible, for lifting apparatus. He discusses and describes several forms of starting devices for motors.—*Elek. Zeit.*, Jan. 11.

Electric Power Transmission in Workshops.—BOWDEN.—An abstract of a paper read before the Glasgow University Engineering Society. The size of generator units depends on local conditions; a good arrangement for a plant requiring 300-hp is said to be to put down two units, one of 200-hp and another of 100-hp. For a very large plant units of uniform size are preferred. In most cases the generator capacity need not exceed 60 to 65 per cent. of the motor horse-power installed. He quotes an instance where 800-hp are installed in motors and only 450-hp in generating units, yet no signs of overload have been noticed. For distribution he advises the splitting of plants into sections and supplying these from panels on the switchboard. He recommends using bare wire for feeders, carrying them on insulators along the shop wall. For driving from the motors, there are many cases where a belt drive could be used instead of more costly gearing. In driving a number of small machines he thinks judicious grouping to a small countershaft to be the best. The motor should be placed so that it drives on the middle of the shaft and not at either end. All motors should be of one or two standard sizes; shunt motors are said to give the best results, though series and compound motors are often rendered necessary by special circumstances; the current should always be left on the shunt coils; against the small amount of energy so used he places the fact that the motor is always kept warm and free from damp, while risk of breaking down due to self-inductive e. m. f. is avoided. He does not favor the use of polyphase machinery for local power distribution.—Lond. *Elec. Eng.*, Jan. 19.

Electric Motors in Dyeing and Calico Printing Works.—An article calling attention to the many advantages of electric motors for such purposes. One of the most serious problems is to provide for the

great variations of speed and in some cases, as in Lancashire, it has been solved by means of a specially devised switch which has something in common with the series parallel controller. In another case, by an arrangement of the three-wire system, it is possible to supply the motors with variations of 100 volts and 200 volts, and by this means it has been found possible to vary the speed of the calico from 5 yards to 60 yards per minute with many intermediate stages. The installation of the Berlin Bleaching, Dyeing & Printing Co., at Oberspree, is briefly described. Some 17 motors, varying in size from 40 down to 5-hp, drive bleaching and drying machinery. In some cases the motors are direct-coupled, in other cases shafting is used, in some instances double reduction gearing and in a few cases triple. Where machines are taking a somewhat small power and working with a fair degree of regularity, power is transmitted to the motor by means of belts and shafting; in such cases the motor is started by means of a liquid resistance. In a table the various details of the machinery driven by the Oberspree factory are given, such as the speed of the motors, their power, the starting appliances, the connection to the machines, the department where they are used and the machinery which is driven.—Lond. *Elec. Rev.*, Jan. 19.

Electric Power in Printing.—A description of the electrical equipment of the printing establishment of the St. Louis *Republic*. The motors are located in pits below the floor and geared to the presses; they are controlled by the combination of teaser and rheostatic control developed by the Crocker-Wheeler Company. The article also illustrates and describes many other applications of the motor.—*Amer. Elec.*, February.

Buffalo.—A description of the transformation of Niagara power into three-wire direct current by the Buffalo General Electric Company. This company operates a large 8000-hp central station delivering constant current for arc light, 60-cycle alternating current for scattered incandescent lights, 500-volt current for motors, and 230-volt current for an Edison three-wire system, but there are no prime movers in its central station. The power is received in the form of three-phase, 25-cycle current at 352 volts. The article describes particularly the several means used for transforming this current into three-wire direct current. The installation consists of two 100-kw 125-volt rotary converters, a 425-kw revolving-field synchronous motor, direct-coupled to two 200-kw shunt-wound generators, each designed to deliver any desired pressure between 130 and 190 volts, and a storage battery to smooth out the daily load curves somewhat by carrying the three-wire load alone without any help from Niagara during the evening. The motor generator, the rotaries, the battery and the feeders are all tied into one set of high, low and intermediate voltage d. c. busbars with ingeniously arranged details; many novel and interesting details are also described. The company contracts to take 3000-hp from the Niagara system; the peak of the load requiring about 3900-hp, of which about 500 is carried by the battery. The demand throughout the 24 hours averages about 2200-hp.—*Amer. Elec.*, February.

Protection of Eléctric Power Transmissions Against Lightning.—Morris—A continuation of the paper (Digest, Jan. 27) giving illustrated descriptions of the Thury lightning arrester; the airblast lightning arrested in which the arc is extinguished by the sudden expansion of air actuating a switch; an Oerlikon condenser lightning arrester and the Fynn arrester, in which the arc is extinguished by subdivisions; the short gap or Wirt arrester, in which the arc is extinguished by contact with a mass of metal; the Siemens lightning arrester, in which the arc is extinguished by the tendency of heated air to rise, combined with the action of the current in the conductor on the arc: the Elihu Thomson arrester, in which the arc is extinguished by repulsion by an electromagnet, and Wurt's non-arcing metal lightning arrester.—Lond. *Elec. Rev.*, Jan. 12 and 19.

Water Power in New England.—A reprint of a short table giving the rates charged per horse-power in a number of different plants. It varies from $20 down to $1.83 for a guaranteed amount for each day in the year; in some cases another rate is charged for the excess over this amount. On the basis of two pounds of coal at $3 per ton, required per hp-hour, steam power would cost $20 or over.—*Eng. News.*, Jan. 25.

Philadelphia.—An illustrated description of the new Callowhill Street power house of the Philadelphia Electric Co., which will have a capacity of 4000-kw when fully completed. Two-phase current, at 91-amp. in each phase, and at 5500 volts and 60 cycles per second, is generated, distributed by underground cables and transformed or converted at other centres for lighting and power purposes.—*Elec. Rev.*, Jan. 24.

REFERENCES.

Polyphase Transmission.—C. F. Scott.—A reprint of a well illustrated paper read before the National Electric Light Association March 1, 1894, and revised by the author in 1899.—*Jour. of Elec.*, December.

Engines for Lighting Stations.—A very well illustrated description of the triple-expansion 3000-hp engines for a power station of the Berlin Electric Light plant (Digest, Nov. 25).—*Eng. News*, Jan. 25.

Traction

Electric Freight Traffic.—Harding.—An illustrated description of an electric locomotive used on a thirty-mile line from Toronto to Newmarket. The central power station is eighteen miles from North Toronto and twelve miles from Newmarket, and contains two 275-kw double-current, 60-cycle, three-phase generators, giving 400 volts alternating current and 570 volts direct current; the direct current is used on the section nearest the station, and the alternating current is raised to 15,000 volts and transmitted to a substation. The freight locomotive, which is illustrated, weighs 57,000 lbs., is equipped with four 50-hp motors and runs at 20 miles an hour on a level, hauling cars with an aggregate weight of 60 tons. There are also some motor freight cars equipped with four 50-hp motors, and others with two of 35-hp. Another electric freight locomotive is illustrated, which is used on the line of the Newburg, N. Y., Electric Ry. Co. for collecting farm and dairy produce and carrying it to the wharf upon the Hudson River. A large freight traffic is also expected on new electric railways of considerable extension in Northern Ohio and Southern Michigan.—*Eng. News*, Jan. 25. Another description of the plant of the Metropolitan Railway Co. of Toronto, in *Amer. Elec.*, February.

Automobiles.—De Contades.—The conclusion of the illustrated article, noticed in the Digest Jan. 6. A Columbia victoria had a battery of Phœbus accumulators, weighing 550 lbs., and claimed to run 43 to 50 miles with a speed of 17.4 miles per hour. The accumulators of the automobiles of the Bouquet, Garcin, Schivre Co. weigh 17.6 lbs., and have a capacity of 110 amp.-hours, if discharged in 5 hours. The Mounard automobile (Digest, Nov. 18) is described.—*Cosmos*, Dec. 23.

REFERENCES.

Electrolysis.—Newbaker.—A general discussion of the means of avoiding electrolysis by the use of independent returns. Potential diagrams show the distribution of potential along the piping to be protected and the adjacent ground, and from these he derives conclusions such as the fact that the protection of one set of pipes endangers another in the same streets. Many practical directions for testing and installing the returns are given.—*Amer. Elec.*, February.

Conduit System.—A reprint, with a few of the illustrations of the English article on the Paris conduit system, noticed in the Digest Feb. 3.—*El'ty*, Jan. 31.

Automobile Frame.—Leroy.—An illustrated description of a frame devised by Solignac, comprising the two front wheels, two motors and the battery. It is complete in itself and may be applied to any kind of body. The weight of the battery is 1100 lbs., that of the whole frame 1650 lbs.—*La Nature*, Jan. 13.

Electromobile Management.—Hanchett.—Some practical rules for drivers, describing what to do in emergencies, especially when the circuit is open or when there are improper connections or short circuits.—*The Automobile*, January.

Installations, Systems and Appliances.

Cambridge.—A long, illustrated description of this plant which now supplies 28,000 lamps of 8-cp and some 8-hp motors; 298,294 kw-hours were furnished in 1899 against 260,307 in 1898. There are six Parsons steam turbine sets, three of 120-kw and one each of 35, 60, 500-kw, direct-coupled to alternators giving current of 2000 volts. There are ten transformer substations. Distribution is now on the three-wire system, partly with 420 volts between the outers and partly with 210 volts between the outers, the change from the old two-wire system having been recently made.—Lond. *Elec. Eng.*, Jan. 12; a shorter illustrated description in Lond. *Elec.*, Jan. 12; an illustrated description of the 500-kw set also in Lond. *Elec. Rev.*, Jan. 12.

Bolton.—An illustrated description of the new plant supplying power to the tramways and to the direct-current lighting mains of Bolton, England. There are two generators, each of 600-kw, which will stand an overload of 25 per cent. for two hours continuously and will be able to cope with fluctuations from 50 per cent. overload down to zero without injurious heating or sparking and without shifting the brushes. There are also two 300-kw generators and two

boosters, one being in the trolley circuit, the other in a return feeder from the rails. At present 25 miles of single track tramway lines are in operation. The lighting system in the centre of the town is being converted from a three-wire 200-volt alternating current network to one using 460-volt direct current.—Lond. *Elec. Rev.*, Jan. 19.

REFERENCES.

Improvements in the Three-Wire System.—ADAMS.—A general analysis of the recent developments of central station distribution with this system. He mentions the increasing size and diminishing number of units and the consequent necessity of providing some means of interconnecting the high, low and intermediate voltage busbars so that a separate pair of generators need not be used for each voltage. The use of batteries for this purpose is mentioned, but the use of small motor generators is recommended. The development of annex stations containing batteries and motor generators is also commented upon.—*Amer. Elec.*, February.

End-Cell Switches.—A description of the arrangement used for automatically stopping at the proper points the motors driving large end-cell switches of storage batteries. The circuits are a trifle complicated owing to the fact that the stopping mechanism must be provided whether the switch is moving in one direction or the other. A diagram of the circuits is given.—*Amer. Elec.*, February.

Melbourne.—Some editorial notes on the new scheme of Arnot for the supply of that city, which is said to be unsurpassed by that of any other city in the world. Arc and incandescent lamps are arranged in series. The central area is to be supplied with continuous current from a three-wire system at 2 x 230 volts and the more distant from transformer stations.—Lond. *Elec.*, Jan. 12.

Synchronizing Alternators.—Some editorial notes on the conditions to be fulfilled in the synchronizing of alternators. They are of a general nature and contain nothing new.—*Jour. of Elec.*, December.

WIRES, WIRING AND CONDUITS.

Interior Wiring.—KNOX.—A continuation of the serial on this subject, taking up in this installment the subject of switchboards of isolated plants and giving instructions for laying out a simple board for one generator with an illustration of a typical board for this purpose with diagram of connections.—*Amer. Elec.*, February.

India Rubber.—TERRY.—A reprint of the article noticed in the Digest Jan. 20.—*Elec. Rev.*, Jan. 17.

ELECTRO-PHYSICS AND MAGNETISM.

Electricity and Magnetism.—FESSENDEN.—The first part of a highly theoretical paper, giving a determination of the nature of the electric and magnetic quantities and of the density and elasticity of the ether. The problem divided itself into two parts: the nature of the quantities involved, and their configuration. A knowledge of the former means a full solution of the problem of the nature of electricity and magnetism, in the same sense, in which we say that we know the nature of sound when we have discovered that it is produced by waves in a medium. Knowing the nature of the electric and magnetic quantities, there is a choice of the suitable configurations, any one of which will be entirely satisfactory; since, however, the true configuration must also account for gravitation and inertia, it would be futile to develop the theory to any extent in connection with a configuration which did not at the same time give promise of results in this direction also. In the present paper he determines the nature of the electric and magnetic quantities and indicates a configuration which may serve for the present, although the determination of a configuration explaining also the nature of gravity is left to the future. He shows that the number of electric and magnetic relations which can be expressed in terms of the electric, magnetic and mechanical quantities, is not sufficient for a solution. There are four unknown quantities: quantity of electricity, quantity of magnetism, specific inductive capacity, and magnetic permeability; and there are as yet only three known independent equations for their determination. The development of a fourth relation or equation is the main result of this paper; he shows that between the magnetizing force and the magnetization there is the following relation: "for all magnetic substances the rate of variation of magnetization with magnetizing force is proportional to the square of the magnetic susceptibility." This leads to a solution, which is confirmed by additional evidence in the shape of other new relations. From one of the latter, data are obtained from which a determination of the density and elasticity of the ether is made. The density is calculated to be 0.66, or two-thirds that of water; the elasticity 6 x 10 to the 20th power.—*Phys. Rev.*, January.

Influence of Pressure Upon the Resistance of Metals and Alloys.—LUSSANA.—An illustrated account of a series of measurements of resistances at various mechanical pressures. Wires of various metals and alloys were wound on ebonite cylinders immersed in oil and subjected to pressures ranging up to 1000 atmospheres. The resistance falls off as the pressure increases, tending toward a minimum value. If an hour elapses between the alteration of pressure and the measurement of resistance, allowing the quantities to settle down to a steady value, the curves taken with increasing and with diminishing pressures are practically the same. When, however, observations of the resistance are taken at frequent intervals, commencing immediately after the alteration of pressure, then in addition to the permanent change in resistance a much larger temporary change takes place, the duration of which depends on the former history of the wire. If the previous condition of the wire has been of a very long duration, the variation in resistance assumes the form of an oscillation about the normal value.—*Nuovo Cimento*, August; a long English abstract by Birks, with three diagrams, in Lond. *Elec.*, Jan. 12.

Models for Illustrating Electromagnetic Phenomena.—GARBASSO.—An illustrated description of a mechanical model, in which e. m. f. is represented by mechanical force, and quantity of electricity by angular displacement. Angular velocity corresponds to intensity of current, and movement of inertia and friction to self-induction and ohmic resistance, respectively. Capacity is represented by a spring connecting certain of the moving parts, and there is an arrangement by which it can be varied during an experiment.—*Il Poleticnico*, January, 1899; abstracted without the illustrations in *Inst. Civ. Eng. Abstracts*, Vol. 138, part 4.

Dielectric Constant of Mixtures of Iron and Paraffine.—BOCCARA and GANDOLFI.—An abstract of an experimental investigation of mixtures of paraffine with various percentages of powdered iron. The dielectric constant increases with an increasing percentage of iron, but there is no proportionality, the dielectric constant increasing more quickly.—*L'Eclairage Elec.*, Dec. 30.

Radioactive Substance.—RUTHERFORD.—An account of an experimental investigation of the property of thorium compounds to continuously emit radioactive particles of some kind, which retain their radioactive powers for several minutes. This emanation has the power of ionizing the gas in its neighborhood and of passing through thin layers of metals, and with great ease through considerable thicknesses of paper.—*Phil. Mag.*, January.

Electromagnetic Rotation.—LECHER.—An article in which he protests against Koenig's allegation that a magnet pole will rotate along the lines of force which encircle an electric current. He describes an experiment and points out that rotation takes place only when the magnetic lines of force cut across a conductor; and that this is the case in Koenig's arrangement, in which the rotation has nothing to do with the motion of a magnet pole along the lines of force.—*Wied. Ann.*, No. 12; abstracted in Lond. *Elec.*, Jan. 12.

Influence of the Height Upon the Terrestrial Magnetic Force.—POCHETTINO.—An account of a series of measurements. He found a variation of the horizontal component of about 0.0005 per 1000 meter of height.—*Rendiconti dei Lincei*, Oct. 15; abstracted in *L'Eclairage Elec.*, Dec. 30.

REFERENCES.

Eddy Currents.—GRASSI.—An experimental verification of his formulas for the energy consumed by eddy currents in copper conductors moving in a magnetic field, in four special cases. The numerical coefficients in his formulas are calculated on the hypothesis that the eddy currents flow in circuits more or less elliptical.—*Il Politecnico*, March, 1899; abstracted in *Inst. Civ. Eng. Abstracts*, Vol. 138, part 4.

Kerr Effect.—ABRAHAM and LEMOINE.—An illustrated English translation of the French Physical Society note, an abstract of which was noticed in the Digest Dec. 30.—*Phil. Mag.*, January.

Electrification of Nascent Gas.—KOESTERS.—A French abstract of the German paper noticed in the Digest Oct. 28; also of an older paper by Townsend on the same subject.—*L'Eclairage Elec.*, Dec. 30.

Electrification of the Atmosphere.—A long abstract of a report of the U. S. Weather Bureau.—Lond. *Eng'ing*, Jan. 5; Lond. *Elec.*, Jan. 12.

Moving Bodies in an Electric Field.—HEYDWEILLER.—A long illustrated abstract of the paper noticed in the Digest Dec. 30.—*Elek. Zeit.*, Jan. 11.

Frictional Electrification.—CHRISTIANSEN.—An abstract of the paper noticed in the Digest Dec. 30.—*Elek. Zeit.*, Jan. 11.

Surface Electrification of Vacuum Tubes.—RIECKE.—An investigation of the distribution of electric charges on the outer surface of

vacuum tubes by means of Lichtenberg's figures.—*Wied. Ann.*, No. 12; abstracted in Lond. *Elec.*, Jan. 12.

Luminescence of Electrodes.—TOMMASINA.—A long abstract of the paper noticed in the Digest Jan. 13.—*L'Eclairage Elec.*, Dec. 30; *L'Ind. Elec.*, Dec. 25.

Influence of Becquerel Rays on Spark Gaps.—ELSTER and GEITEL.—An illustrated abstract of the paper noticed in the Digest Dec. 16.—*Elek. Zeit.*, Jan. 11.

Spark Discharge in a Magnetic Field.—TOEPLER.—An illustrated abstract of the paper noticed in the Digest Dec. 16.—*Elek. Zeit.*, Jan. 11.

Cooling Device for Röntgen Tubes.—LEROY.—An illustrated description of the device of Buguet and Chabaud, referred to in the Digest Nov. 25 and Dec. 9.—*La Nature*, Jan. 6.

Röntgen Rays.—An article of a general nature giving a summary of the development of our knowledge of the X-rays.—*Cosmos*, Jan. 6.

Terrestrial Magnetism.—BELLAGAMBA.—An experimental investigation of the influence of the atmospheric pressure, in determinations of the horizontal component of the terrestrial magnetism.—*Rendiconti dei Lincei*, June 3; abstracted in *L'Eclairage Elec.*, Dec. 30.

Terrestrial Currents.—An article, illustrated by diagrams, on earth currents observed in submarine telegraphic cables to Zikawei, China.—*Cosmos*, Jan. 13.

ELECTRO-CHEMISTRY AND BATTERIES.

Accumulator Tests.—HOSPITALIER.—A long preliminary official report of the long, competitive accumulator tests under the direction of the Automobile Club of France, which were repeatedly referred to in the Digest. Each battery had to weigh not more than 242 lbs. without containing box and to give 120 amp.-hours, if discharged at a constant rate of 24-amp. during 5 hours, while the voltage was not to drop below 8.5 volts. Whenever it fell below this value, the battery was to be taken out of the circuit; if it was taken out four times, it was definitely disqualified. The recharging was accomplished in eight hours as a maximum, with a current diminishing from 30-amp. at the start to 15-amp. at the end. During the intervals of rest the manufacturers were allowed to look after their batteries, to adjust the density of the electrolyte and to clean the cells, but not to alter any plate or to add anything. The tests took place six times a week. Once a week the batteries were discharged at a constant rate of 24-amp. during 5 hours and when below 8.5 volts, they were taken out of the circuit. At the other five days the discharge was rather irregular (as described in the Digest Dec. 30 under Sherrin Accumulator), in order to approximate the conditions of automobile work. Arrangements were also made to subject the batteries to mechanical shocks on these five days, but owing to defects in the apparatus for this purpose, the jolting was only given to the accumulators during some 122 hours of the whole time of test. There were 26 discharges at constant rate and 127 discharges at irregular rates, the total being 765 hours. Eighteen batteries entered in the tests. Some batteries were from the start unable to stand the conditions of the tests, and the committee reported only on the eight which sustained at least 60 complete discharges before failure, namely, the Metaux, Pollak, Tudor, Pescetto, Blot-Fulmen, Fulmen, Prenix, Pope (Sherrin type), their weights without containing box being 210, 242, 237, 234, 216, 149, 203, 220 lbs. respectively. The total energy taken by these batteries in kw-hours per lb. of total weight was 0.65, 0.55, 0.95, 0.98, 0.89, 1.04, 0.89, 1.00; the total energy in discharges in kw-hours per lb. of total weight was 0.36, 0.33, 0.57, 0.56, 0.61, 0.69, 0.59, 0.71. The average efficiency was 56, 56.5, 60, 57, 68, 66, 66, 70. The time interval between the first charge of a certain battery and its last discharge is called the "official life of the battery." During the official life, all the batteries were supposed to be charged and discharged a certain number of times, even though any one battery may not have reached this limit. This number is called the official number of charges and discharges during the life of the battery and gives the maximum limit to which the actual charges and discharges approach the more regular the behavior of the battery has been. The official number of charges and discharges was 82, 82, 141, 141, 135, 100, 103, 135; while the number of real charges was 82, 82, 139, 141, 135, 100, 103, 135 and the number of real discharges 71, 77, 135, 128, 132, 98, 102, 135. Some other specific factors of the eight batteries, their sizes and the weights of the single parts are also given. A fuller report is promised.—*L'Ind. Elec.*, Jan. 10; *L'Elec.*, Jan. 13; a long abstract in Lond. *Elec. Eng.*, Jan. 19. (In the *Elec. Eng.* abstract the French units of length and weight are converted into English, but in some cases apparent mistakes have been made. In the foregoing abstract, the correct values, calculated from the French article are given.)

Electrochemical and Electrometallurgical Industries.—KERSHAW.—The conclusion of his article (Digest, Feb. 3). The progress in the utilization of ozone on a commercial basis has been slow; the numerous trials with ozonized air for the purification of potable waters are being continued. A new method of producing ozone, devised by Moissan is referred to and it is said that it may become of industrial importance. Fluorine gas is produced by the electrolysis of a fluoride and is passed into water at 0° C.; a gas containing 14.39 per cent. ozone by volume and quite free from nitrogen compounds can be obtained. The progress of the different zinc processes is briefly outlined. The Hoepfner process is coming into use, its success being largely due to the fact that chlorine is produced as a by-product at the anode, and that therefore the total cost of the electrical energy and of the operating charges, can be divided between the bleaching powder, in which form this chlorine finds a ready sale, and the zinc. Reference is also made to the Fry process; one-third of the plant in which it is used is completed and in operation, and the results obtained are said to have quite equaled the expectations.—Lond. *Elec. Rev.*, Jan. 19.

Electrolytic Gas Development.—CASPARI.—At ordinary temperatures hydrogen is liberated at 1.55 to 1.56 volts, and with higher e. m. fs. a mixture of oxygen with an excess of hydrogen is obtained; at about 100° hydrogen is produced at 1.33 volts; after long electrolysis hydrogen peroxide or persulphuric acid is present. With spongy platinum electrodes the cathodic electrolysis is completely reversible, but with other metals an excess of tension is required for liberating hydrogen and the electrolysis is not reversible.—*Zeit. f. Phys. Chem.;* abstracted briefly in Lond. *Elec. Eng.*, Jan. 12.

Influence of Pressure Upon the Resistance of Solutions.—TAMMANN.—An article in which he shows that as the dissociation in solutions increases with the pressure, an increase of conductivity occurs if an electrolyte is compressed. This was observed in the case of a decinormal solution of acetic acid which, at ordinary atmospheric pressure, is far from being completely dissociated; exposed to a pressure of some 2500 atmospheres, the resistance falls to half its original value. In the case of a decinormal solution of sodium chloride which is already dissociated to a far degree at ordinary pressure, the resistance shows a fall of only about 9 per cent. when a pressure of 2500 atmospheres is applied.—Lond. *Elec.*, Jan. 12.

Ionization Heat.—HOLLARD.—A summary of the researches of various investigators concerning the heat toning due to the formation of ions which occur, according to Arrhenius, when a salt is dissolved in water. The thermodynamical investigations are briefly reproduced and in three tables the values of the ionization heat of elements are given, i. e., the heat absorbed or set free by the passage of an element into the ionic state, and of the heat absorbed or evolved at the anode when a metal passes into the solution as ion. The ionization heat of a salt is equal to the sum of the ionization heats of its ions.—*Rev. Gen. des Sc.*, Dec. 30; a full English translation begins in Lond. *Elec. Eng.*, Jan. 12.

Polarization of Water Containing Gases.—FEDERICO.—An investigation of the dependency of the maximum e. m. f. of polarization of water, upon the gases dissolved in it. The maximum e. m. f. of polarization is diminished by the solution of air or gases in the water. The influence of different gases is not the same: it is greatest for oxygen, smaller for hydrogen, and not observable for nitrogen.—*Il Nuovo Cimento*, Vol. 9, p. 191; abstracted in *L'Eclairage Elec.*, Dec. 30.

REFERENCES.

Electrochemistry in 1898.—A continuation of the article noticed in the Digest Dec. 30 and Jan. 6, giving short descriptions, taken from patent specifications, of new electrolytic methods of producing alkalies, several oxides, sulphides, chlorates and salts, aluminates, silicides and carbides.—*Elek. Anz.*, Dec. 17.

Apparatus for Electrolysis.—BEADLE.—An illustrated description of some apparatus to be used in the electrolysis of fused salts.—Lond. *Elec. Rev.*, Jan. 19.

Ozone.—An account of the results of experiments made in Berlin, to sterilize water by ozone.—*Revue d'Hygiene*, Nov. 20; abstracted in *L'Eclairage Elec.*, Dec. 30.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electric Units.—FLEMING.—The conclusion of his long article (Digest, Jan. 20 and Feb. 3) proposing a new nomenclature. Instead of electric and magnetic force he suggests the terms voltivity v and gaussivity g. There are four intrinsic properties of the aether and of matter; the permeability p, the susceptibility u, the permiti-

vity *k*, which is the present dielectric constant, and the conductivity *c*. There are four corresponding physical states: *g* acting through *p* produces flux *f*, which is the present induction or number of lines of force per unit of cross-section; *g* acting through *u* produces magnetization *m*, which is commonly called intensity of magnetization; *v* acting through *k* produces displacement *d*, by which is meant the elastic or reversible movement of electric charge across any plane, and that when the voltivity is removed, the displacement disappears either immediately or in course of time; *v* acting through *c* produces conduction, *q*, by which is meant the permanent passage of electric charge on bodies conveying it through a section of the circuit or path and measured by the quantity of electricity so conveyed. These quantities are related by four simple equations: $f = pg$, $m = ug$, $d = kv$, $q = cv$. By a dot over a quantity he denotes its time differential, by a dot under a quantity its time integral. Voltivity and gaussivity are vector quantities and can be distributed either in a noncircuital manner where the time integral around a closed line is zero, or in a circuital manner, where this time integral has a finite value. The line integral of the voltivity is voltage *V*, that of gaussivity is gaussage *G*, the present m. m. f. The surface integrals of flux, magnetization, displacement and conduction are called fluxage, *F*, displaceage *D*, magnetage *M* and conductage *Q*. *G* acting through permeance *P* produces *F*, *G* acting through susceptance *U* produces *M*. *V* acting through permittance *K* produces *D*. *V* acting through conductance *C* produces *Q*. *P*, *U*, *K*, *C* are integral qualities of the magnetic and electric circuits in which the effects are produced. All these quantities are related by four simple equations: $F = P\,G$, $M = U\,G$, $D = K\,V$, $Q = C\,V$. Some more simple interconnections are also developed. It appears that there are 10 specific quantities, denoting states or qualities at points in the medium and represented by small letters, and ten corresponding integral quantities denoting states or effects added up along lines or over sections of circuits and represented by capital letters. Of the ten specific quantities, five are electric and five magnetic. The phenomena presented by dielectrics under the action of voltivity can be simply explained by supposing that the permittivity is divisible into two parts, one part such that the corresponding displacement responds instantly to every change in the voltivity, and one part varying so that the displacement is a function of time of application of the voltivity and of its magnitude. In addition there is superimposed in the case of all material dielectrics some degree of true conductivity. The whole of the phenomena exhibited by polar magnets are easily intelligible if it is admitted that flux and magnetization are essentially quantities of a similar nature, as far as voltage production in an embracing electric circuit is concerned, and are therefore additive in their effects in certain cases. Moreover, in the magnetic circuit the sum of the two must be continuous in amount, hence where magnetization ends or terminates—that is, where magnetic poles occur—these regions must be the starting point for new flux; in other words, sources of gaussivity must exist. In considering the two circuits, electric and magnetic, there is an analogy between magnetization and displacement, and also between flux and conduction, in the following respects: under indefinitely increased gaussivity the magnetization of every ferromagnetic tends to a limit, and in the same manner, under indefinitely increased voltivity the true elastic displacement tends to limit, beyond which, however, rupture of the dielectric occurs. On the other hand, flux and conduction can be increased, as far as we know, indefinitely with continually increasing gaussivity or voltivity, but with this difference: that under constant voltivity the conductivity of the electric circuit permits a continuous process of conduction to go on with continuous dissipation of energy, whereas in the magnetic circuit under constant gaussivity there is no change in the flux and no dissipation of energy. Hence the four specific states—flux, magnetization, displacement, conduction—can be divided into two classes; the necessary circuital, including flux and conduction, and the not necessarily circuital, viz., magnetization and displacement. The first group may be furthermore divided into the nondissipative state, flux, and the dissipative state, conduction. All the electric and magnetic phenomena, with which we are acquainted can be simply described and discussed in terms of these ten defined specific and integral quantities. The analogies of the magnetic and electric circuits, their interactions and relations, are properly displayed by this nomenclature, and not concealed, as by the existing terminology and system of units. He thinks a reform of our present terminology and system of units advisable and concludes with the remark that the above outlines of a scheme are not intended to be a dogmatic or self-assertive expression of the direction such a reform should take, but merely a contribution to a discussion of the subject.—Lond. *Elec.*, Jan. 12.

Locating Faults in Dynamos.—RICHTER.—A very long illustrated article. After some references to a method devised by Froelich (Digest, March 18, 1893), he describes one, the feature of which is the graphical representation of the potential along the conductor under test. In his diagram the position of any point of the conductor, measured by its distance from a given starting point, is represented by the abscissa, the potential at that point by the ordinate. If for instance an earth contact of a cable is to be located, the potential difference against the earth is measured at the two end points of the cable which is supplied with current; the two values will have opposite signs. The length of the cable is drawn as axis of abscissas, and at the ends the potential differences against the earth are plotted as ordinates in the proper direction; then the intersection of the junction line of the ends of the ordinates with the axis of abscissas gives the point where the potential of the cable is that of the earth, i. e., the point of the fault. Instead of the graphical method a simple analytical calculation can be used. Some modifications of this method are described, also some corrections in the equations, which may become necessary in practice. He then discusses an exactly analogous graphical method for locating a fault in the armature of a dynamo. If the armature is a single closed circuit, a current is passed through it between two points, which divide the length of the armature into two equal halves, and the potential differences of the different parts of the collector against the core are measured, the results being potted in a diagram, as before. A modification of this method is described when the fault is not a direct core contact, but still has a considerable resistance. If it is possible to cut the armature open at a point, the method becomes very simple; one of the ends where it is cut is connected to one pole of a source, the other pole of which is connected with the core. Between the other cut end and any two points of the armature, the potential differences are measured and the results plotted graphically. If there is a short circuited coil the potential line will be parallel to the axis of the abscissas at the corresponding points; to draw the potential line in this case, a larger number of measurements is necessary.—*Elek. Zeit.*, Jan. 11.

REFERENCES.

Measuring the Phase Shifting in Three-Phase Motors.—BREITFELD.—A long French abstract of the German article noticed in the Digest March 4.—*L'Eclairage Elec.*, Dec. 30.

Method of Measuring Resistances.—WEBER.—A French abstract, with two diagrams, of the German article noticed in the Digest Sept. 30 and Oct. 7.—*L'Eclairage Elec.*, Dec. 30.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Designing a Telephone Plant.—DOMMERQUE.—An article on the main points which are to be considered in the design of a telephone plant. In a smaller city where one office can take care of the entire business, its proper location is important, which may be found as follows: on a map of the city all subscribers, actual and prospective, are plotted, then a line is drawn from west to east, dividing the whole number of the subscribers into two equal parts, and another line from north to south, dividing this number also into two equal parts; the cross-section of the two lines is the proper place to locate the office. He shows analytically, how the sum of the lengths of all lines increased by having the office at any other place. He then discusses the case of larger cities. In all systems used by the Bell Telephone Co. in this country, an office containing 6000 subscribers is the largest which is practicable; the European Bell company recently completed an office in Paris with 9100 subscribers; and the Kellogg divided system affords space for 24,000 subscribers in one office. In order to determine how many offices should be installed, the interest and depreciation on the plant plus annual running expense for the exchange should be calculated, for one office, for two, three, and so on, and that number of offices should be chosen for which the cost is a minimum. Besides the quality of service is to be taken into consideration. With more than one office, two-thirds to three-fourths of the calls go over trunk lines and must be handled twice, both in the outgoing and in the incoming office, so that the number of employees is nearly doubled; the installation itself is more costly on account of the additional trunking sections; the quality of telephonic transmission suffers, since nearly three times as many office cables and twice as many contracts in the talking circuit have to be used, while often during the busiest hours all trunks are in use. He describes how to plot a curve representing the average sub-

scriber's distance in feet, as a function of the number of offices in the exchange. This curve for Chicago is given in a diagram. For 1, 2, 4, 8, 16, 60 offices, the average length of subscriber's line is 20,900, 13,333, 10,000, 6666, 5000, 2500 feet respectively. If the cost of line mileage, interest and depreciation on switchboard plant, cost of operation, maintenance, fixed charges, cost of current supply and rent, are represented graphically, always using as abscissas the number of offices in the exchange and as ordinates the average cost per subscribers, and if all these curves are added, a summation expense curve is obtained; where this has the minimum value, that particular number of offices is to be used.—*Tel. Mag.*, January.

Insulation of a Bare Telegraph Wire Laid on Ice.—Lespieau and Cauro.—An account of the results of an experimental investigation made on Mont Blanc. If a bare telegraph wire is laid on ice, the loss to the earth is very small; telegraphy is therefore possible with such wiring.—*L'Eclairage Elec.*, Dec. 30.

REFERENCES.

Wireless Telegraphy on Mont Blanc.—J. and L. Lecarme.—A more extended illustrated description of the experiments, noticed in the Digest Nov. 18 and 25.—*Cosmos*, Jan. 13.

Electric Signaling.—Steiger-Dieziker.—An illustrated description of the Vester system, by means of which alarm signals are given from a central station to one of more receiver stations, the time of the beginning of the alarm and that of the stopping, which is to be accomplished by the receiver station, being registered by an automatic electromagnetic device.—*Schweiz. Blatt. fuer Elek.*, Jan. 8.

Railroad Signals.—Coleman.—A continuation of his long, illustrated serial on electropneumatic interlocking signals at the New South Terminal Station in Boston (Digest, Dec. 30). The interlocking machine is described.—*Railr. Gaz.*, Jan. 26.

Electric Signal.—An illustrated description of a device for an electric train order signal for locomotives (intended to prevent the occasional overlooking or forgetting of train orders and special orders; the signal is given by an electric bell.—*Eng. News*, Jan. 25.

Electrical Time Service.—A long abstract of the discussion which followed the paper of Hope-Jones, noticed in the Digest Jan. 13.—Lond. *Elec.*, Jan. 12.

New Books.

Electric Power Transmission. A Practical Treatise for Practical Men. By Louis Bell, Ph. D. Second Edition. Revised and Enlarged. New York: Electrical World and Engineer. 505 pages, 230 illustrations. Price, $2.50.

The second edition of Bell's "Electric Power Transmission" appears to be in large measure a reprint of the first edition, with the addition of a chapter regarding some recent installations. Rereading this book in its new form is a most instructive lesson in the growth in all directions of electricity supply and transmission. In 1897 the author still considered it worth while to speak of constant-current transmission, and to quote as a case of power transmission the famous Frankfort-Lauffen experiment, which now seems to have mainly a historic value. To-day European practice is generally so far behind American that it is no longer necessary to cross the Atlantic to find the best examples of good engineering. At that date few transmissions of over twenty miles had been attempted, and alternating arc lamps were not to be considered a success. The latter point, as well as the statements regarding limiting pressures to be used on transmission lines, and safely to be generated directly, are corrected in the new final chapter.

The most noticeable change in the last two years is in the status of the rotary converter. If the present rate of increase of this class of apparatus continues there will soon be more current passing through the commutators of rotaries than through those of direct-current generators in central stations. The general use of alternating-current transmission from steam-driven central stations, in connection with direct-current distributing systems, has been a development of the last two years, and in 1897 the author considered rotaries deserving of but little space in his book.

Such omissions should not, however, make us forget the virtues of Dr. Bell's book, which admirably covers a field where collected and well analyzed information would be quite lacking without it.

The descriptions of the form and working of alternate-current machinery are excellent and the names of the companies manufacturing the various pieces of apparatus discussed are given so that the practical man can gain much benefit from these chapters. The general facts regarding prime movers are clearly and interestingly stated in a way to aid in forming a general judgment as to types of apparatus to be used in particular cases.

The discussion of transmission lines and distributing systems is excellent. Such development as has been made during the past two years has been in the directions indicated by the author. The formulæ for the strength of wire and dip in spans are rarely used, but are in simple form for reference. As is stated, the insulator pins are nearly always the weak point mechanically of transmission lines, and detailed calculations of the strength of the other parts of the system are usually quite useless. To-day aluminum seems to be in the field as a competitor of copper as a conductor, but the advance in that direction cannot yet be foretold.

In the chapter on the commercial aspects of power transmission, the point that the market for power is of primary importance, is emphasized. A more careful regard for this on the part of promoters of schemes for hydraulic development would undoubtedly save them much trouble, or others considerable loss. The most important point to be considered in developing a transmission scheme is the market, and next is the business management which will enable the electric apparatus to displace the old machinery without the necessity for making ruinously low rates, as an inducement to change.

The final chapter in the book is all new, containing a review of Mr. Mershon's experiments on very high-voltage transmission, and a list of all plants now operating at 10,000 volts or more, with a description of two or three of the most interesting. A short description of recent development is also given, particularly in regard to increased operating pressure and alternating arc lamps, as well as to improvements in motors.

American Telephone Practice. By Kempster B. Miller. New York: American Electrician Company, 458 pages, 357 illustrations. Price, $2.00.

The general character of this work, and the simplicity of its treatment, as well as the logical manner in which the author progresses, step by step, over the field, make it a valuable acquisition to any man who is interested in telephony, whether layman or engineer. No attempt is made at mathematical treatment, and the book is eminently practical throughout.

Without making any invidious comparisons, it may well be said that none of the able works on telephony which have before been given to the public have been produced under quite the same advantages as this. An abstract treatise on whatever subject has much less force than one coming from a man known to be in daily and intimate contact with the practical side of his subject. Of course, Mr. Miller has been well known for some time by reason of his contributions to the technical press; but few even of those who have met him professionally are aware of the variety of his experience. He experimented in telephony, and built telegraphic and telephonic apparatus even before going to college. After being graduated from Cornell University he spent some time in the drafting room of large electrical works in Lynn, Mass., and then entered the United States patent office as an assistant examiner. Here he was speedily assigned to electrical work, and became thoroughly acquainted with telephone patents, a matter of great importance, as in this art more than any other, perhaps, the patents contain the best history of its development. Mr. Miller left the patent office to go with the Westinghouse Company, afterwards assuming charge of one of the largest independent telephone factories in the country. From there he went to the Scranton Correspondence Schools as instructor, and is now again in charge of a very large telephone factory. It can thus be seen that he has had the advantage of intimate connection with every source of telephonic knowledge, both theoretical and practical, and has taught as well as studied.

The opening chapter of the book deals with the history and the underlying principles of the magneto telephone, proceeding from Oersted's discovery to 1876, when Bell and Gray simultaneously produced successful speaking instruments. Successive chapters treat of the battery transmitter, the receiver, carbon transmitters and batteries, the chapter on carbon transmitters being specially interesting by reason of its clear explanations. A study of this chapter in certain respects would go far toward relieving the feeling of tension caused by the Berliner patent in the minds of the Independents. Another of interest is that on induction coils, because of facts that are presented in condensed form for ready reference.

In dealing with systems and switchboards, and in fact throughout, Mr. Miller has been strictly fair in his treatment and presenta-

tion of the Bell side of the case, but the fact is still very patent that the best descriptions in the book relate to the apparatus of independent manufacturers. This is probably partly due to the difficulties always met with in obtaining information respecting Bell exchanges.

The closing chapters of the book relate to construction work, including both underground and overhead, and to testing; and some very convenient tables are given for both. Taken all in all, the subject has been fully and satisfactorily treated, and the book should have a large sphere of usefulness.

BOOKS RECEIVED.

GENERATOREN MOTEREN UND STEUERAPPARATE. Fur Elektrisch Betriebene Hebe und Transportmaschien. By Dr. F. Niethammer. Berlin: Julius Springer. 423 pages. 805 illustrations. Price, 20 marks.

COMMERCIAL AND BUSINESS ASPECTS OF MUNICIPAL ELECTRICITY SUPPLY. A Practical Handbook for the Use of Electrical Engineers to Municipal Corporations and Members of Municipal Electricity Committees. By Alfred H. Gibbings. New York: The Macmillan Company. 270 pages, 57 illustrations. Price, $4.00.

Directory of Electrical Societies, Etc.

NEW YORK ELECTRICAL SOCIETY. Next meeting, Feb. 23.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York. Next meeting, Feb. 28.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., July, 1900.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Chicago, May 22, 23 and 24, 1900.

CHICAGO ELECTRICAL ASSOCIATION. Next meeting, Feb. 16. Paper: "The Electrolytic Deposition of Metals," by C. F. Burgess.

AUTOMOBILE CLUB OF AMERICA.—Mr. A. L. Riker, on Electric Automobiles, Waldorf-Astoria, 8:30 p. m., Feb. 10.

Transformers for Niagara Falls Power Company.

THE Union Carbide Company utilizes 15,000-hp out of the 50,000 generated by the Niagara Falls Power Company. Three of the immense generators are devoted to this service. The new works of the Union Carbide Company, made necessary by the greatly increased demand for their product, are situated a little over two miles from the Niagara Falls power station. A difficulty arose in transmitting the 2200-volt current of the power station to the Union carbide works on account of the overheating of the conduit. It was therefore found preferable to step-up the current from 2200 two-phase to 11,000 volts three-phase for transmission to the Union carbide factory. On account of the high efficiency of the transformers employed in this service, and also in the decreased expense of conductors, by using high tension current, this method was found to offer economical advantages.

This transformer station is at present the largest constructed, and contains seven of the largest transformers which have ever been made, consisting of seven Westinghouse 1875-kw or 2500-hp oil-insulated transformers. The exterior and interior of one of these units are shown in Figs. 1 and 2. Receiving the currents at 2200 volts two-phase, they are stepped-up to 11,000 volts three-phase by the Scott system, and upon reaching the carbide works are passed through two sets of transformers, and reduced to 110 volts for heating the product in the furnaces of the carbide company.

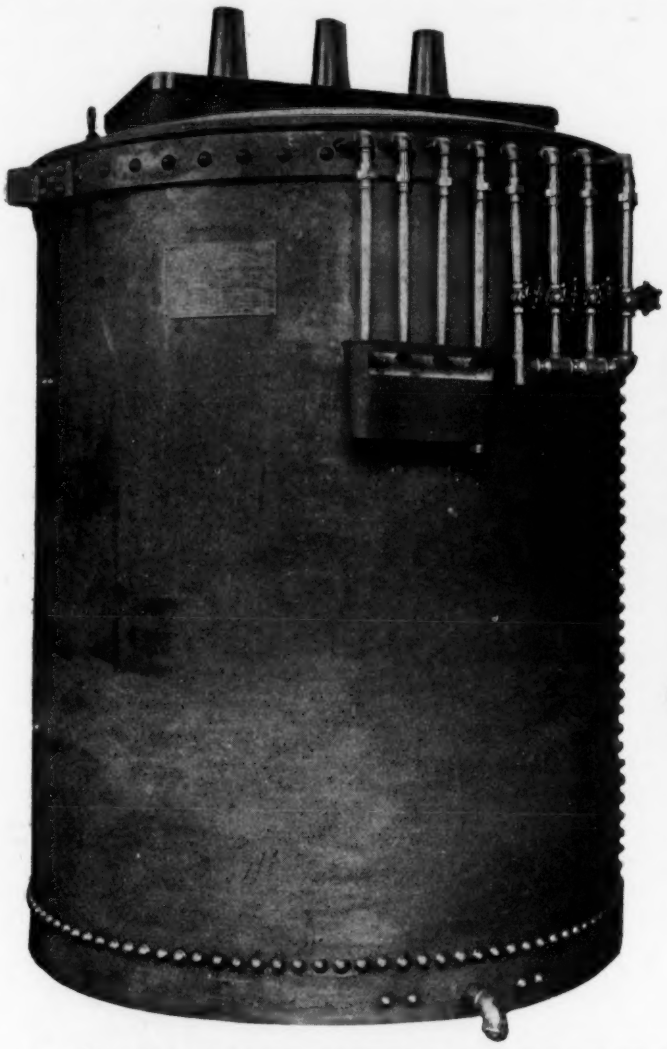


FIG. 1.—1875-KW TRANSFORMER, STEPPING UP 2200-VOLT TWO-PHASE CURRENTS TO 11,000-VOLT THREE-PHASE CURRENTS.

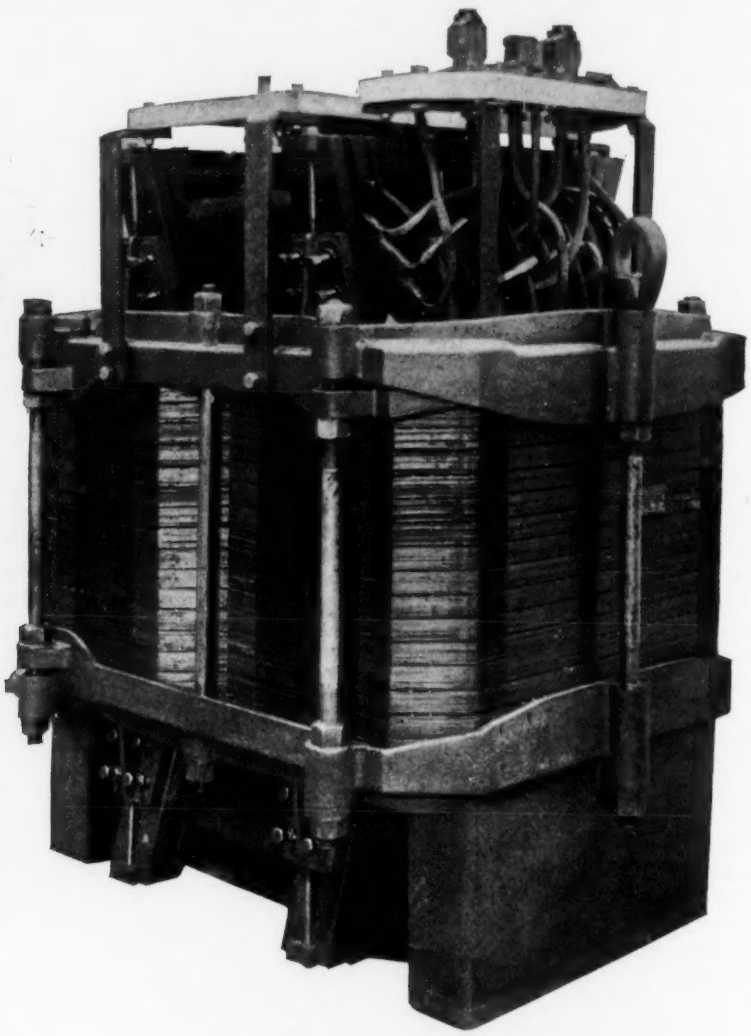


FIG. 2.—INTERIOR OF 1875-KW TRANSFORMER.

The transformers are about nine feet in height with a diameter of seven feet. The weight of each one, including the oil for insulation, is about 30,000 pounds. They have stood most severe tests, and have actual working curves of efficiency far higher than have ever been previously realized on high voltage transformers. From the first day the plant was operated they have given perfect satisfaction and have performed their work in the most successful manner without a single interruption, which testifies to able designing and construction.

The view of the interior shown in Fig. 2 displays the end of the

coils at the top and bottom of the transformers spread apart, to secure a maximum exposure of cooling surface to the oil. Spacing strips built in at regular intervals as the iron is assembled increases the surface of iron exposed to the oil. The primary and secondary are interleaved to reduce magnetic leakage, and thus improve regulation, and several terminals are brought out from both primary and secondary to provide for obtaining different transformation ratios. The primaries of the transformers are designed to take either 2200 or 4400 volts two-phase and deliver on their secondary either 4400, 11,000 or 22,000 volts three-phase. Connections are also provided for raising any of the voltages on the secondary side 5 per cent.—the primary voltage remaining the same—and still other connections are provided so that any transformer can be used as either the main or teaser of a Scott-connected pair. The secondary voltage of the teaser of such a pair of transformers should be about 13 per cent. less than the secondary voltage of the main. This may be secured either by winding the secondary with a 13 per cent. smaller number of turns and a correspondingly larger cross section, or by simply cutting out and leaving idle 13 per cent. of the turns. A new method has been adopted in the design of these Westinghouse transformers, for the secondary voltage is reduced by cutting in more turns on the primary or low tension side of the teaser than are used in the primary side of the main, all high tension copper being left in, in either case. The density in the iron core is lower in the teaser, owing to its greater number of primary turns, so that its secondary voltage is lower than that of the main. In a similar way the 5 per cent. increase of secondary voltage for regulation purposes is secured. Five per cent. of the turns of the primary side are cut out, which increases the core density and the electromotive force per turn at the same impressed voltage.

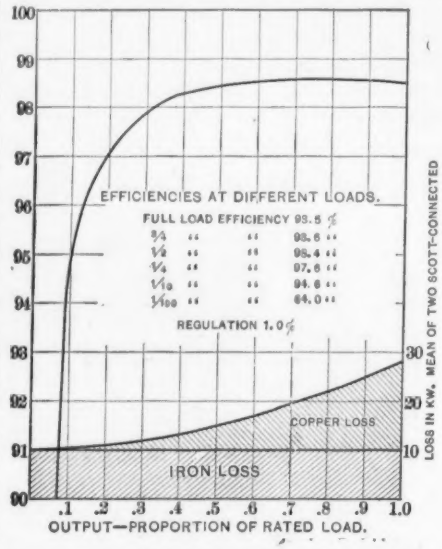

EFFICIENCIES AT DIFFERENT LOADS.
FULL LOAD EFFICIENCY 93.5 %
¾ " " 93.6 "
½ " " 93.4 "
¼ " " 97.6 "
1/10 " " 94.6 "
1/100 " " 64.0 "
REGULATION 1.0 %
COPPER LOSS
IRON LOSS
OUTPUT—PROPORTION OF RATED LOAD.
LOSS IN KW., MEAN OF TWO SCOTT-CONNECTED

FIG. 3.—TRANSFORMER REGULATION CURVES.

On the high-tension side of each transformer there are 600 turns connected in six separate circuits running from the terminal board within the transformer casing, the middle of each circuit being also tapped out to the terminal board. Four of these circuits have 120 turns each, while two of them have only 60 turns each. These 600 turns are all connected in series for 22,000 volts, two in parallel and 300 in series for 11,000 volts, and five in parellel and 120 in series for 4400 volts. The middle point of each parallel part through the transformer must always be brought out for connection to the teaser when the transformer is used as a main. The leading current in one side and the lagging in the other are made to neutralize each other, and this is accomplished without magnetic leakage by interleaving the windings. Upon the primary or low tension side of each transformer there are 272 turns connected throughout in two parallel paths. For 4400-volt supply these double paths are connected in series, but for 2200-volt supply they are connected in parallel. For normal ratios of transformation all the secondary turns are used, but to obtain the 5 per cent. increase in the secondary voltage the three-turn sections are cut out. When the transformer is used as a main the eight-turn sections are cut out, while for use as a teaser these eight-turn sections are cut in, thereby reducing the e. m. f. per turn, and consequently the secondary pressure to the proper value for the teaser side of the Scott connection. One incoming lead to the spare transformer is connected through a throw-over switch mounted on a transformer case. When the switch is closed in one position the whole number of primary turns are cut in, and when closed in the other position the proper number are cut out to change the transformer to a main.

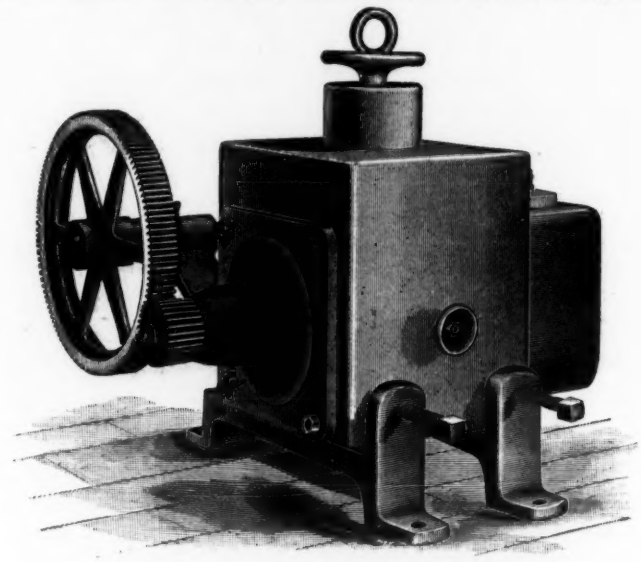
The regulation of these transformers is 1 per cent., or, in other words, the secondary voltage falls off only 1 per cent. upon the application of full non-inductive loads from the voltage at no load, the potential applied remaining the same. When working at 11,000 volts secondary this drop of voltage amounts to about 110 volts. The curves shown in Fig. 3 are the average of two of these Westinghouse transformers, connected up to change from two-phase to three-phase. These curves include the increased copper loss in the secondary of the main and the diminished iron and increased primary copper losses of the teaser. The efficiency, therefore, is not quite as high as if the transformers were used with the same number of phases on the primaries as upon the secondaries.

In the transformer room each feeder, consisting of four single conductor cables for the four sides of the two-phase system, leads from the generator switchboards and ends in a switchboard panel. This panel carries two circuit breakers, one in each side of each phase, also throw-over switches for substituting a spare transformer for any one of the others. The high-tension winding of the spare transformer ends in flexible cables which can be carried down the battery of transformers and connected up temporarily in place of any one of the regular transformers which may fail at any time.

As usual for the Scott transformation of phases, the secondaries of these transformers are connected up, one terminal of one secondary, the teaser being connected to the center of the other secondary, the main, the three other terminals giving three-phase currents. These three terminals are carried to high tension panels, where they pass through three ammeters and three switches and thence to the cables leading to the transformer substation at the other end of the line. At this point the transformers are similarly connected to give two-phase secondary from three-phase primary, the connections at both ends of the line causing the current to go from teaser to teaser and from main to main.

Stow Ironclad Multi-Speed Electric Motor.

The accompanying illustration is of an ironclad multispeed motor just ready to be placed upon the market by the Stow Manufacturing Company, Binghamton, N. Y. This machine is designed for direct-connection. Its speed regulation is effected in the manner described in an article in the ELECTRICAL WORLD some months ago when referring to the Johnson patent upon which it is based. Briefly, the speed of the machine is varied by changing the intensity of the field magnetism, this being accomplished by changing the position of a movable central core within one of the poles of the field magnet, thus varying the mass of metal. The company claims that this system of regulation



IRONCLAD MULTI-SPEED MOTOR.

enables it to reduce the weight and simplify the construction of the machine by dispensing altogether with a speed regulator.

The motors are of the bipolar enclosed type, with toothed laminated drum armature, hard drawn copper commutator segments, radial type brush holders of ample size to carry the maximum load, and automatic self-oiling bearings. They have a large starting torque and will stand a 50 per cent. overload for a short time without sparking. The larger motors have a greatly increased range of speed, showing as high as 70 per cent. between the highest and the lowest. The machine is advantageous for direct connection to machine tools, particularly where a variety of speeds is desirable.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET marked what appears to be the beginning of better conditions, the favorable showing of the metal securities having a good deal to do with the improvement. In the local field, lighting securities were firmer, but traction securities bobbed up and down, chiefly down, in wonderful fashion. During the week, 1840 shares of Western Union were sold, closing at 86¼, a gain of ¼. On sales of 3870 shares, General Electric advanced to 128, a gain of 5 points. Brooklyn Rapid Transit, on 129,286 shares, gained 3⅞, up to 75⅛. Metropolitan Street Railway, on 25,225 shares, gained 5⅛, up to 172½. The prodigal son, Third Avenue Railway, on sales of 100,000 shares, went off 10⅝, to 99⅜, a loss of about $150 a share in a single year. And yet there is a magnificent property. Manhattan Elevated, on 32,506 shares, gained 3¾, up to 96⅛. In Boston, the closing quotations were: American Bell Telephone, 345-348; Erie, 104¾-105; Michigan, 100-105; New England, 135-140; Mexican, 2¾-3; Mass. Electric, 23 common, 77 pref.; West End, 93; Boston Elevated, 100¼. In Chicago, closing prices were: National Carbon common, 18½; Metropolitan Elevated common, 25½; South Side Elevated, 100; Lake Street Elevated deb., 89½. In Philadelphia, closing prices were: Electric Storage Battery common, 80-80½; preferred, 80-81; Penna. Elec. Vehicle common, 7⅝; pref., 5¾; General Elec. Automobile, 5⅛; Am. Railways, 4⅞-5; Elec. Co. of America, 12⅝-12¾; Phila. Electric, 5¾; Phila. Traction, 97⅛; Union Traction, 39¼; Consol. Traction, N. J., 62¼; Consol. Traction, Pittsburg, 28¾-29. In the outside market in New York, Elec. Axle, Light & Power sold at 3⅝-4¼; Elec. Boat common, 17-20; pref., 35; Elec. Vehicle common, 44-47; pref., 60-75; N. Y. Elec. Veh. Trans., 9¼-9¾; New England, 6-6½; Illinois, 2-2¾; General Carriage Co., 4-4¼; Otis Elevator common, 22-25; pref., 87-90.

NEW YORK LIGHTING.—Mr. William C. Whitney made public last week the following statement regarding his purchase of Standard Gas Light Company stock: "The purchase by me through Mr. Braman of Mr. Sage's Standard Gas stock has no significance whatever. I did not buy the Andrews stock. It was a bargain day, and I, with persons associated with me in electric light interests, holding gas stocks as well, added this purchase to our other holdings. We owned other Standard gas stock at the time, and simply increased our holdings. The Consolidated people had bought the Westinghouse Electric Comanpy and proposed to enter the electric light field, and, of course, it was perfectly fair for us to enter the gas field if we could get there." This refers to the plant of the United Electric Light & Power Company. This situation, which enabled each side to see that the other was in a good position to make a fight in the joint field of gas and electricity, led those concerned to realize also that it was better to come together than to fight. The result was the sale of the New York Gas & Electric Light, Heat & Power Company to the Consolidated Gas Company, in return for Consolidated Gas securities, which included incidentally a $2,000,000 issue of Consolidated interest-bearing notes. The details of the transaction have already been noted in these pages.

THIRD AVENUE DEBT.—Mr. Edward Lauterbach has made the following statement as to the plan for taking up the Third Avenue Railroad Company's floating debt: The company has arranged to exchange all of its present indebtedness into 6 per cent. notes, secured by mortgage running for three years with a privilege to the company to retire any or all of the same at the end of any twelve months. These notes will not contain any clause permitting their convertibility into stock. This disposes of all the company's requirements with the exception of $2,500,000 or $3,000,000 of further indebtedness which may be incurred in connection with the completion of construction work. No payment will be necessary for some time to come in competition with any such expenditures and the company has at least two different methods of obtaining any supply of money for this last named purpose and upon terms perfectly fair to the company. Within a very short time after the issuance of the interest-bearing notes it is the intention to present a plan to the stockholders for the permanent funding of the company's debt and for all other necessary purposes, the principal feature of which will be a low rate bond to be first offered to the stockholders, but underwritten by a syndicate.

SOUTHERN NEW ENGLAND TELEPHONE.—At the annual meeting of the Southern New England Telephone Company the old directors and officers were re-elected. The annual report for the year ended Dec. 31, 1899, compares with three previous years as follows:

	1899.	1898.	1897.	1896.
Gross earnings.....	$689,005	$595,831	$552,466	$503,716
Expenses and interest..	525,495	430,656	397,424	391,814
Balance	163,516	165,175	155,042	111,902
Dividends	150,660	150,660	103,491	86,250
Surplus	12,850	14,515	51,551	25,652

The number of stations in Connecticut on Dec. 31, 1899, was 12,697, an increase for the year of 2108. Public toll stations increased 65 for the year. The company's wires now reach 157 out of the 168 towns in the state. The average rental for 1899 was $40.26 per station and $45.25 in 1898, a decrease of $4.99. The 2108 stations added during the year were at an average rental charge of $15.10 per station.

NEW YORK LIGHTING CONSOLIDATION.—Certificates formally merging six concerns into the New York Gas & Electric Light, Heat & Power Company, of New York City, have been filed with the Secretary of State. The merged concerns were the Block Lighting & Power Company, No. 1; the Borough of Manhattan Electric Company, the Manhattan Lighting Company, the Mount Morris Electric Light Company, the New York Heat, Light & Power Company, and the North River Electric Light & Power Company. The New York Gas & Electric Light, Heat & Power Company was itself, as already noted, recently absorbed by the Consolidated Gas Company, of New York City. The capital stock of the several companies absorbed was: North River Electric Light & Power Company, $400,000; New York Light, Heat & Power Company, $375,000; Manhattan Lighting Company, $250,000; Mount Morris Electric Light Company, $1,500,000; Block Lighting & Power Company, No. 1, $98,000; Borough of Manhattan Electric Company, $1,000,000. Total, $3,623,000.

ERIE TELEPHONE.—The Erie Telephone Company subscription to 20,000 shares of treasury stock closed last week. The full amount of stock was subscribed by purchasers of rights and stockholders. New stock is payable Feb. 14. Before taking over the two big opposition companies of Michigan, the Erie Telephone Company had Messrs. Stone & Webster, the Boston engineers, report upon the cost value of these properties. They reported that the replacement value of the Detroit property was $650,000, and of the New State Telephone Company of Michigan $690,000. The latter had no debt, but the Detroit company had $585,000 bonds outstanding. The combined stock of these companies outstanding was $1,363,000, and this the Erie Telephone Company secured at 50 cents on the dollar. This is said to be the total investment of the Erie Company, as the bonds of the Detroit Company are not disturbed, though they may be taken up later, and would be purchased at the reported price from the west of 80 cents on the dollar.

TELEPHONE CONSOLIDATION SOUTH.—Articles have been filed at Louisville, Ky., consolidating the Cumberland Telephone & Telegraph Company and the Ohio Valley Telephone Company with a capital of $10,000,000. The company operates in Kentucky, Tennessee, Illinois, Mississippi and Louisiana under Bell patents. The Cumberland Telephone & Telegraph Company had a capital stock of $6,000,000. The capital stock of the Ohio Valley Telephone Company was $1,000,000, and it operated in Kentucky and Indiana. Old stockholders will receive share for share of new stock for their old stock. The Cumberland Telephone Company has also purchased the People's Telephone Company, of New Orleans, whose capital is $600,000 and bonded debt $400,000. It was an independent concern organized under Detroit auspices.

PENNSYLVANIA MANUFACTURING COMPANY, which controls the great bulk of the electric lighting of Philadelphia, held its annual meeting on Feb. 5. President McCall submitted a report which shows that the income from all the companies was $1,121,650. After payment of the fixed charges, including interest on the Philadelphia Electric 5 per cent. bonds and dividends on stocks, there is shown a surplus of $58,473. The stock of the Philadelphia Electric Company, which absorbed the Pennsylvania Manufacturing and the National Electric Companies, was active and higher on the strength of the above statement.

AMERICAN DISTRICT TELEGRAPH.—The annual report of the American District Telegraph Co., of New York City, for the year ending Dec. 31 shows surplus after dividends $80,153. All the old directors were re-elected. Mr. Edwin Gould and George B. Wilson were elected to fill two vacancies. The gross earnings were $612,934. The company has 1510 miles of wire, 85 offices; 27,986 instruments, 1145 messengers. It answered 4,965,229 calls, delivered 5,033,523 telegrams and distributed 7,904,129 circulars. Its

name is mysteriously mentioned in connection with new telephone work.

BELL TELEPHONE PLANS.—There are reports current in Boston that the absorption of the American Bell Telephone Co. by the American Telephone & Telegraph Co., official preliminary announcement of which was made recently in these pages, has been postponed until the fall. The reason assigned for the delay in carrying out the plan is that the passing of necessary legislation, particularly at Albany, will require a longer time than anticipated, and that also it has been deemed best to let the matter rest during the present session of the Massachusetts legislature.

WESTINGHOUSE COMMON DIVIDEND.—The Westinghouse Electric Manufacturing Company has placed the common stock on a 5 per cent. dividend basis, having declared the first quarterly dividend of 1¼ per cent. This fact was regarded as an indication that the prosperity in this line of business has resulted in large profits. An official of the company intimates that the next annual report will show very large surplus.

BERLIN IRON BRIDGE.—At the annual meeting of the stockholders of the Berlin Iron Bridge Company, held at the office of the company in East Berlin, Conn., on Monday, January 29, the capital stock of the company was increased to $750,000. The following Board of Directors was elected: Chas. M. Jarvis, Frank L. Wilcox, S. H. Wilcox, H. H. Peck, Geo. H. Sage, D. E. Bradley and Seymour N. Robinson.

AMERICAN STEEL & WIRE COMPANY decided last week to pay a dividend of 7 per cent. for the year on the common stock, and the first quarter instalment of 1¾ per cent. will be paid Aprfl 2. There has since been considerable strength in all the iron and steel stocks.

Commercial Intelligence.

THE WEEK IN TRADE could hardly have been improved upon, and there is noticeable a strong tone everywhere, even such branches of industry as might have been affected by the open winter reporting good conditions. The coal market, for example, is in excellent shape, and productive activity has been so great in various lines, that the manager of an electrical factory situated right on one of the great coal lines complained to us last week of the difficulty he experienced in keeping up his supply of fuel. As to the activity in electrical trade, it is demonstrated by the fact that the Westinghouse Electric & Manufacturing Company has declared a dividend on a 5 per cent. basis on the common stock of $10,000,000. This is in addition to the 7 per cent. dividend on the $4,000,000 of preferred stock and 5 per cent. interest on the $3,500,000 of bonded indebtedness. Such earnings represent, as in the case of the General Electric Company, an enormous volume of output. Railroad earnings testify to an active paying business being done by the country's transportation interests. For the third week of January 64 roads report gross earnings of $8,566,000, a gain of 14.9 per cent. over the same week a year ago. For the month of December 48 roads report a gain in gross earnings of 9 per cent., but a gain in net of 11.2 per cent. Street railway earnings are also running well. It is estimated that New Yorkers are now paying $70,000 a day for their travel in the city. Failures are few and liabilities are small, though this period of the year usually witnesses a large number of business embarrassments. The total number of failures in the United States during the month of January, as reported to Bradstreet's, was 1122, a decrease of 10 per cent. from January a year ago, of 27 per cent. from January, 1898, and of 40 per cent. from the same month in 1897, while as compared with 1896 failures were only about half as numerous. Liabilities aggregate $10,180,879, 28 per cent. smaller than in January, 1899 or 1898, and less than half as large as those for January, 1897. Assets aggregated only 40 per cent. of liabilities, a very low proportion, and were 39 per cent. smaller than in January a year ago. Business failures for the week numbered only 171, as compared with 252 the previous week, 207 in the same week a year ago, 295 in 1898, 305 in 1897 and 338 in 1896. In the metal markets conditions are steady, and prices are even hardening. Steel rails are quoted at $35; copper, Lake ingot at 16½ cents, lead at 4.70 cents.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York during the week ended Jan. 27: Argentine Republic—286 cases electrical material $23,761; 2 cases electrical machinery $603. Amsterdam—1 case electrical material $125. Alexandria, Egypt—1 case electrical material $20. Bristol—62 packages electrical machinery $4000. Brussels—1 package electrical material $22. Brazil 8 cases electrical material $460. British Australia—2 cases electrical machinery $1133. Cuba—140 cases electrical material $4449. Central America—3 cases electrical material $101. Dutch Guiana—1 case electrical material $50. Frederickstad—5 cases electrical material $140. Glasgow—6 cases electrical material $211. Hamburg—139 cases electrical material $10,819. Liverpool—6 cases electrical machinery $223. Leeds—3 cases electrical machinery $181. Milan—19 cases electrical material, $1716. Mexico—12 cases electrical machinery $1226. Newcastle—2 cases electrical machinery $300; 3 cases electrical material $370. Rotterdam—1 case electrical material $15. Riga—5 cases electrical material $1558. Southampton—2 cases electrical material $40. Tasmania—53 packages electrical material $3310. For the week ending Feb. 3 the exports were as follows: Antwerp—14 cases electrical material $1561. Argentine Republic—179 cases electrical machinery $13,441; 59 cases electrical material $2924. Amsterdam—7 cases electrical machinery $1200. British West Indies—197 cases electrical machinery $11,245; 21 cases electrical material $806. British East Indies—3 cases electrical machinery $605. Brazil—250 cases electrical material $9143. Bremen—1 case electrical material $50. British Guiana—12 cases electrical material $200. China—25 cases electrical material $523. Central America—40 cases electrical material $1319. Chile—22 cases electrical material $1082. Ecuador—5 cases electrical material $34. French West Indies—2 cases electrical material $42. Frankfort—1 case electrical material $25. Glasgow—31 cases electrical material $1203; 12 cases electros $265. Havre—75 cases electrical machinery $3717; 205 cases electrical material $30,986. Japan—10 cases electrical material $1799. London—26 cases electrical material $2022. Liege—2 cases electrical material $200. Mexico—158 cases electrical material $6944. Marseilles—35 cases electrical material $1353. Nova Scotia—2 cases electrical machinery $188. Newfoundland—6 cases electrical material $123. Puerto Rico—13 cases electrical material $449. Peru—20 cases electrical material $323. Southampton—52 cases electrical machinery $1101. Siam—44 cases electrical material $240. Trieste—14 cases electrical material $356. U. S. Colombia—13 cases electrical material $103. Venezuela—29 cases electrical material $277.

IMPROVED HOUSE BUILDING.—The man who wants to build houses that will sell in the future must see to it that full provision is made for electric current supply. The charging of automobiles is but one of the newer uses to which current will be put, and there is, moreover, an opportunity to work out a definite plan of concentrated supply, so that a resident in a row of houses can enjoy as many conveniences as if he lived in a modern apartment, without giving up his privacy of life. "The Girard Estate in Philadelphia is soon to try an experiment which I have often thought would prove successful in New York," said recently a real estate dealer, "and I have no doubt but that it will be tried here some day. Every man who owns a house in New York and who has even given the subject any thought knows that there is a lot of waste in the running of it which might be saved if he combined resources with his neighbors. The trustees of the Girard Estate are going to demonstrate that fact. They proposed to build a block of dwellings near Girard Park in the southern part of Philadelphia which will be furnished with light and heat from a central plant for a comparatively small addition to the rent, and I believe that they can do it with profit." It is high time people on any given street resolved themselves into a trust for the better supply of light, heat and power—unless a company will serve them more cheaply.

THE O. C. WHITE COMPANY, of Worcester, Mass., manufacturers of adjustable electric light fixtures, report brisk business, especially in their ball and socket joint "adjustable holder" for factory and shop use. They have recently installed four hundred of these in the Boston & Albany Railroad paint shops at Allston, Mass. Mr. W. E. Hibbard, master painter for this road for over a quarter of a century, states that the convenience of these fixtures in work of this kind can hardly be overestimated. A rod thirteen feet long is fastened to the ceiling by a ball and socket joint. At the end of this rod is attached the swiveling and sliding cone joint, in which swings a rod of any desired length. To this is attached the wrist joint and the lamp. With this fixture the lamp can instantly be turned into any desired position either inside or outside of the car. The obvious advantage of a fixture of this kind in shops like the above or in factories among moving and shifting belts can readily be seen. Among representative concerns using these fixtures are the following: Westinghouse Machine Company, Pennsylvania Railroad shops at Sayre, Pa.; Washburn & Moen Manufacturing Company, American Steel & Wire Company, Carnegie Machine Works, Locomobile Company of America, Bryant Electric Company, Hendey Machine Company, Pond Machine Tool Works and several hundred others.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., are putting up two large buildings for the National Coal Tar Company at Everett, Mass.; a gas plant for the Peekskill Gas Company, at Peekskill, N. Y.; a retort house for the Penn Yan Gas Light Co., at Penn Yan, N. Y.; a large car barn and power house for the electric railroad at Montville, Conn.; the iron roofs for the new plant of the Nichols Chemical Company, at New York; two large buildings for the J. H. Horn & Sons Company, at South Lawrence, Mass.; a machine shop for the Wheeler & Wilson Manufacturing Company, at Bridgeport, Conn.; a new power station at

Tariffville, Conn.; a new machine shop for the Norwalk Iron Works at South Norwalk, Conn.; a large steel building covering Pier No. 13, at New York; a power house for the Middletown, N. Y., Gas & Electric Company, besides a large number of smaller contracts. They are running their plant full time, and report business exceedingly brisk.

THE MISSISSIPPI VALLEY TELEPHONE COMPANY, Minneapolis, Minn., have recently placed an order with the Stromberg-Carlson Telephone Manufacturing Co., Chicago, for the complete equipment for a branch exchange in St. Paul, and also additional equipment for increasing the Minneapolis exchange, which is being made up and furnished as rapidly as possible. While the completion of the two exchanges has been somewhat delayed, owing to the scarcity of raw material, it is, however, progressing as rapidly as can be expected in a system of this extent. The two exchanges, when completed, will represent an investment of more than a million dollars, and all the capital has been furnished by J. C. Hubinger, "America's Starch King," of Keokuk, Iowa. They will without question, be the largest individual telephone services in the independent field. The plants are first class metallic throughout, and are equipped with the S-C. "Central Energy" system and multiple switchboards. Both the Minneapolis and St. Paul exchanges are already in operation and the plants are being rapidly extended.

VALLEE BROS.' ELECTRICAL COMPANY is the new style of the old firm of Vallee Bros.' & Company, of Philadelphia, the new company having acquired all the assets of the preceding organization and assumed all its liabilities. The capital stock is $300,000, and the officers are: Garrett A. Vallee, president; George W. Vallee, vice-president; Frank D. Sweeten, treasurer, and W. H. Grove, secretary. The headquarters will be at 625 Arch Street, Philadelphia, but in the near future a broader policy than has been followed hitherto will prevail, and the company will operate fully equipped supply houses in Baltimore, Md., and Norfolk, Va., where they have already a large number of customers to study. This development of a well-known Philadelphia electrical concern will be noted by the trade with much interest and good-will. The determination of the Quaker City to keep in touch with its large territory is highly laudable.

FRANK S. DE RONDE COMPANY is a new concern bearing a well-known name. It has been organized by Mr. F. S. De Ronde, formerly general manager of the Standard Paint Company, of New York City. We understand from him that it is the intention of the company to make a specialty of insulating paints, and that it will push particularly "Lythite," a cold water paint of high qualities for all indoor and outdoor purposes. The company will also handle paint for electric light, street railway, telegraph and telephone poles, central station and railway power house appliances, etc., and will deal in electrical and mill supplies of a kindred nature. The De Ronde Company has opened offices at 54 John Street, this city, and 48 North Fourth Street, Philadelphia. Mr. De Ronde has the exclusive agency for the P & B paints, etc., for Pennsylvania, Southern New Jersey and Delaware.

THE CHICAGO BELTING COMPANY reports that it has been busier for some time past than ever before in its history and that it has found it necessary to nearly double the capacity of its factory. Even with these increased facilities night work has been necessary in order to keep up with the orders. Within the past two months the company has manufactured two 72-inch three-ply belts, one for the McCormick Harvesting Machine Company, and the other for Maxwell Bros., of Chicago. The company also secured a contract for about $5000 worth of belting for the Illinois Car & Equipment Company, and another large contract for the Grand Crossing Tack Company. The company has recently installed in its factory a number of modern machines as well as belt presses.

UNITED METAL SELLING COMPANY.—The copper business of Lewisohn Bros., of this city, has been organized into a stock company called the United Metal Selling Company, with capital stock of $5,000,000. The new company will also be a selling agency. The directors are H. H. Rogers, William Rockefeller, Leonard Lewisohn, Adolph Lewisohn and Charles C. Beaman. The companies represented by the new company are as follows: The Lake Superior mines, which include the Osceola Consolidated, Tamarack, Isle Royale, the Arcadian, the Amalgamated Copper Company's properties and the Anaconda. Mr. Lewisohn estimated that the amount of copper which they handled during the year would be about 400,000,000 pounds, or more than 70 per cent. of the country's output. The concern sells a great deal of copper to electrical concerns.

BOSTON EDISON COMPANY, for the extension of its Atlantic Avenue property, has placed a contract for the building with Norcross Bros. for $200,000. It has bought four boilers of the Babcock & Wilcox Company fitted with their superheaters and chain grate stokers. The generating plant will comprise an engine from the McIntosh, Seymour Company, with a 250-volt General Electric Edison generator in the centre. The company has also ordered a central condensing plant of the jet type from the Blake Manufacturing Company; also vertical feed pumps of the same manufacturer and an open air secondary feed water heater of the Cochrane type. Another Chloride battery of 5000 amperes will be installed, and a 50-ton crane has been ordered from the Morgan Engineering Works.

REFRIGERATION PLANTS.—The Independent Ice Co., of Baltimore, has given contract to the York Manufacturing Co., York, Pa., for a 100-ton icemaking machine and 75-ton freezing system. Their present plant, which is 60 tons capacity, will be enlarged to accommodate the new machinery. Their present plant was erected one year ago by the same concern, to which the Virginia Brewing Co., of Roanoke, has also awarded contract for a 7-ton icemaking and refrigerating plant, which is to be installed at once. The Empire Building, in Pittsburg, will be equipped with a refrigerating plant for cooling the drinking water used in the building. Contract for the machinery has been awarded to the York Co.

WESTERN ELECTRIC ABROAD.—A special despatch from Chicago of recent date says: The Western Electric Company has sent 72 of its most skilled operatives to its plant in Belgium, which has been furnished throughout with American machinery. The men are being sent to teach native workmen the uses of the machinery and the manner of constructing telephone and other electric devices after American methods. The operatives have been guaranteed American wages for a year, by which time, it is believed, the native artisans will have become sufficiently adept to carry on the work.

NATIONAL CARBON.—It is said that the National Carbon Company has acquired an invention which manufactures carbon in increased quantities and on a more economical basis than the machinery heretofore used, and that with this new machine the company will be enabled to enter the European field and undersell the market there. Mr. A. J. Eddy will resign from the Board of Directors of the National Carbon Company at the forthcoming meeting. The change is made at his request, he realizing that the company has no need of a Chicago director.

MANNING, MAXWELL & MOORE, whose principal offices are at 85, 87 and 89 Liberty Street, New York City, are compiling a new catalogue devoted exclusively to the illustration of iron working machine tools. Those who have new tools that they would desire to have illustrated in this catalogue should immediately communicate with Manning, Maxwell & Moore, at their New York office, marking their communication "Catalogue Department," which will insure its receiving prompt attention.

GEO. C. TOWLE MANUFACTURING COMPANY, Lancaster, Pa., manufacturers of power motors, desk fans, ceiling fans, etc., inform us that they have given the European agency for their fans to H. M. Salmony & Co., Ltd., London, England. That concern handled their fans with such great success in the season of 1899, they have now had this agency awarded to them for the whole of Europe covered by their salesmen.

STANDARD CABLES.—The Standard Underground Cable Company have recently closed contracts for cable with the Pittsburg & Allegheny Telephone Company, the Atlantic Coast Cable Company, of Atlantic City, N. J.; the Bell Telephone Company, at Philadelphia; the Delaware & Atlantic Company, of Philadelphia, and for the electric light cables for the Independent Electric Light & Power Company, San Francisco.

THE SPRAGUE ELECTRIC COMPANY has contracted to furnish and install complete for the Plymouth Cordage Company two 75-kw direct-connected generating units, each consisting of a 14 x 14 Ames engine and a 75-kw split-pole generator. The Sprague Company has also received an order for two 30-kw generators to be used in the works of the Whitehall Portland Cement Company, at Cementon, Pa.

COMMERCIAL MUSEUMS.—A bill has been introduced in both Houses of Congress appropriating $200,000 for the Philadelphia Commercial Museum, its object being to enable the institution to increase its facilities for the benefit of the American manufacturer and exporter. It is believed that this work is worthy of public support, in order that its sphere of influence and usefulness may be enlarged.

BIG REPAIR SHOP.—The Boston Elevated will build a large repair shop in Charlestown, near Sullivan Square, on land recently purchased. The new buildings will cover a ground area of 47,250 square feet and will have a capacity of 75 cars. The equipment in tools, machinery, etc., will run into a good deal of money.

THE WOODWARD & ROGERS COMPANY, of Hartford, Conn., report brisk business in the electrical field in their vertical drilling machines. They have recently shipped six 4-spindle drilling machines—balance of a big order—to one of the largest electrical concerns in this country.

Special Correspondence.

NEW YORK NOTES.

New York, Feb. 6, 1900.

THE FIRE DEPARTMENT'S PORTABLE SEARCHLIGHT.—Another practical test was afforded a few nights ago of the new portable searchlight outfit of the New York fire department, which apparatus was described and illustrated in these columns on Jan. 20. The machine was used at a fire on Mott Street and rendered great aid to the firemen, who were enabled to render better service by reason of the illumination from the powerful projector. The light penetrated the smoke and the firemen were able to move about the upper floors with as much safety as by day.

THE TROY STRIKE SETTLED.—The strike of the employees of the United Traction Company, of Troy, N. Y., which began on Jan. 21, was brought to a settlement on Jan. 29, when traffic on all the lines was resumed. This strike was unique in that no disorderly act was committed during the strike period. Concessions were made on both sides to bring about a settlement. The old hands went back to work at 20 cents per hour for regular men and 18½ cents for "trippers," all time on cars to be paid for, whether the cars are moving or not. The original demand of the men was for a uniform schedule of 20 cents per hour for all employees.

REMOVAL OF J. H. BUNNELL & CO.—The business of J. H. Bunnell & Co. has recently grown to such proportions as to make a change to more spacious quarters necessary. The concern has leased the entire building at 20 Park Place, which has five floors besides the basement and sub-basement, and is equipped with freight and passenger elevators. Mr. Charles McLaughlin, the surviving member of the old firm of J. H. Bunnell & Co. and who was the active manager of it from the beginning, is at the head of the new concern, and is aided by the former corps of assistants in the various departments, who will be pleased to have all their friends and patrons call and see the new quarters which are now being fitted up. The advantages of concentrating a large business, in all its departments, are many, and Mr. McLaughlin is emphatically the executive who can make the most of them. The host of friends and patrons of the old concern will find it better equipped than ever, as to appliances for manufacturing and facilities for doing business, and a larger trade than in any previous year is confidently expected. Mr. McLaughlin is receiving a flood of congratulations and good wishes from all quarters on his admirable new departure.

WESTERN NOTES.

Chicago, Ill., Feb. 3, 1900.

MR. JACOB LOOMIS, of the Lea Manufacturing Company, Ellwood, Ind., was in Chicago this week on business.

STREET RAILWAY TUNNELS.—The city law department is drafting an ordinance to compel street railway companies using river tunnels to lower them in conformity with government requirements.

MR. JAMES A. MYERS, of the Robbins & Myers Company, Springfield, Ohio, was in Chicago several days this week in the interests of his company. Before returning home he will visit the Foundrymen's National Association Convention at Detroit.

THE STERLING ELECTRIC COMPANY, Chicago, manufacturer of Bell style telephone apparatus and exchange equipment, has opened an office at 1260 Monadnock Building, where its friends and customers will be welcomed. The company reports that its business is rapidly increasing.

Pittsburg, Pa., Feb. 3, 1900.

THE MILLER ELECTRICAL COMPANY.—William Bader was appointed receiver of the Miller Electrical Maintenance Company, of this city, by William McKinley, the local sheriff. The assets of the company are said to be $10,000, while the indebtedness amounts to $15,000.

THE NEW OFFICE BUILDING of the Westinghouse Electric Company at East Pittsburg is now completed, and the removal of the offices from the old place is now going on. The new building is seven stories high, and the accommodations it will afford for the offices are said to be unexcelled.

FIRE.—The old factory of the Westinghouse Electric & Manufacturing Company, located on Garrison Alley, Pittsburg, caught fire last Tuesday night. The Westinghouse Company left the building in 1894 and removed to East Pittsburg. The old building is now occupied by the R. D. Nuttall Company. The origin of the fire has not been discovered. The damage amounted to about $10,000.

CANADIAN NOTES.

Ottawa, Ont., Feb. 3, 1900.

THE OTTAWA CARBIDE WORKS.—Within a few days the new building of the Ottawa Carbide Works will be opened at the Chaudiere Falls, Ottawa. The old structure was badly wrecked two months ago by an explosion caused by water running into a superheated crucible. The new building is entirely fireproof, the only inflammable material in it being the wooden sashes of the window frames. Subsequent to the explosion referred to, the civic committee of investigation in its report recommended that in carbide manufacture the pigs should be cooled in a room separate from the furnaces, and this feature has been followed in all its details. The new plant consists of six large furnaces, double that of the old plant, all of which will be operated.

THE BRITISH PACIFIC CABLE.—Concerning the London cable stating that the Colonial Office has permitted the government of New South Wales to grant the Eastern Extension Cable Company a subvention of land for its line, Sir Wilfrid Laurier has received several cablegrams from Lord Strathcona bearing upon the subject. A message received from the Canadian high commissioner corroborated the newspaper report, and impressed upon Sir Wilfrid Laurier the necessity of making an immediate protest, and he has communicated with the Hon. Mr. Chamberlain, objecting to his sanction of the action of the New South Wales government, and pointing out that it was fraught with menace to the success of the all-British Pacific cable scheme. The Dominion government has received from the representatives of all the colonies interested, excepting New South Wales, strong expressions of disapproval with any course that will interfere with the successful and early completion of the enterprise. Inquiry in well informed circles at the Dominion capital revealed a strong impression that, despite the leaning of the Colonial Office, and the alleged lukewarmness of New South Wales, the wishes of the friends of the all-British cable scheme in England and of the people of Canada and Australasia, will result in the defeat of the forces which are conspiring against the Pacific cable project as approved last spring.

General News.

THE TELEPHONE.

THE WISCONSIN TELEPHONE COMPANY will erect a new exchange building at Madison, Wis.

ROCHESTER, MINN.—The Winona Telephone Company has completed its telephone line into this city.

THE WAPAKONETA TELEPHONE COMPANY, of Wapakoneta, Ohio, has increased its capital stock from $10,000 to $25,000.

EMERADO, MINN.—The Northwestern Telephone Exchange will extend its wires from this place to Mekinock early in the spring.

SPOKANE, WASH.—The Canadian Telephone Company has brought mandamus proceedings against the city to compel the issuance of a franchise.

THE COLUMBIANA COUNTY TELEPHONE COMPANY in Ohio has about 1200 subscribers in its district, and the plant is rapidly being installed.

JUNCTION CITY, OREGON, will soon have a telephone exchange in operation. Sodaville will be connected with Albany by telephone in a short time.

LAMONI, IOWA.—The Lamoni Telephone Company has been incorporated with a capital of $5000. Incorporators, B. Teale, W. A. Hopkins, all of Lamoni.

SULLIVAN, VA.—The Moultrie County Telephone Company has been incorporated. Capital, $10,000. Incorporators, James Morrison, Jr., C. A. Hight, C. Lane.

BOSTON, MASS.—E. B. Callender, of this city, has petitioned the general court for an act which provides for telegraph and telephone supervision in the commonwealth.

CHICAGO, ILL.—The Chicago Telephone Company has filed a certificate of increase of capital stock of the company from $5,000,000 to $15,000,000, in order to extend its system.

NORTH TONAWANDA, N. Y.—The Bell Telephone Company is seeking a local franchise. The Twin City Telephone Company, a local concern, is also in the field for a franchise.

NEWPORT NEWS, VA.—A charter has been granted to the Phoebus Telephone Company for Phoebus and the counties of Elizabeth City, Warwick and York. Capital stock, $10,000.

DETROIT, MICH.—The new State Telephone Company is building a new state line between Detroit and Ann Arbor, 40 miles long, for the relief of the line to Jackson and Kalamazoo.

LOWELL, MASS.—The Independent Telephone Company, of New Orleans, with 4000 subscribers, has been transferred to the Cumberland Telephone Company. The latter is a Bell company.

KANSAS CITY, MO.—The Missouri & Kansas Telephone Company will, it is reported, expend $500,000 in the next 12 months in extensions and improvements of the service in and around this city.

SAN FRANCISCO, CAL.—The Sunset Telephone & Telegraph Company will build an additional line direct from San Francisco into Nevada. There will be a loop of heavy copper weighing 430 pounds to the mile.

SHARPSBURG, PA.—The Federal Telephone Company has been granted permission to establish a telephone system in this place. It proposes to charge $18 per year for residence service and $24 for business houses.

RICHMOND, IND.—At the annual meeting of the Richmond Home Telephone Company the following officers were elected: President P. J. Freeman; vice-president, J. W. More; secretary and treasurer, J. M. Lentz.

ST. LOUIS, MO.—The Western Union Telegraph Company has refused to pay the franchise tax levied by the state board of equalization, on the ground of illegality. The case will be taken to the Supreme Court.

WHEELING, W. VA.—The Home Construction & Telephone Company, of Wheeling, has been incorporated. Capital, $200,000. Incorporators, G. Hook, A. Paull, W. A. Wilson, H. S. Sands, W. T. Shaffer, all of Wheeling.

PORTLAND, ORE.—The Pine Tree Telephone & Telegraph Company has been incorporated, with headquarters in this city. Capital, $10,000. Incorporators, J. W. True, J. W. Winter, C. P. Chandler, all of New Gloucester.

STROUDSBURG, PA.—A scheme is on foot to organize the Cherry Valley Telephone Company to build lines from here to Saylorsburg. Among those interested are Hon. N. M. Lesh, Jeremiah Fetherman and A. H. Fetherman.

THE FEDERAL TELEPHONE COMPANY has been granted the right by a special meeting of the borough council of Bellvue, Pa., to erect poles and build a line. The rate for business telephones is to be $24 and for residences $18.

CARMICHAELS, PA.—The Carmichaels Telephone Company has been incorporated to construct and operate telephone lines. Capital, $1000. Incorporators, C. J. Lincoln, L. Myers, F. Blackshore, T. L. Lincoln, H. G. Lincoln, all of Carmichaels.

HARRISBURG, PA.—The Telephone, Telegraph & Cable Company of Pennsylvania, of Philadelphia, has been incorporated. Capital, $25,000. Incorporators, J. J. Sullivan, C. M. Swain, C. A. Porter, J. B. McCall, W. McLean, Jr., all of Philadelphia.

THE WESTERN CONSTRUCTION CO., of Bryan, Ohio, has completed the installation of a telephone system for the Eaton Telephone Company, which controls the toll connection for nearly every town in Preble County. The system is very complete.

WARREN, OHIO.—The Jefferson & Warren Telephone Co. has increased its capital stock from $40,000 to $100,000. Its lines will be extended into western Pennsylvania and several new lines will be built to towns in Trumbull County, Ohio.

INDIANAPOLIS, IND.—The National Telephone Company has completed stringing a new metallic circuit between this city and Kendallville. This closes up the gap and forms the connecting link for through copper metallic wire service from Fort Wayne to Cleveland.

CHATTANOOGA, TENN.—The Alabama & Tennessee Telephone Company, of Chattanooga, has been incorporated. Capital, $50,000. Incorporators, G. C. Steel, M. Humes, N. K. White, W. I. Wallman, T. W. Pratt, W. B. Sevaney, R. B. Cook, P. T. Farnsworth, all of Chattanooga.

BELLE PLAIN, IOWA.—The Enterprise Telegraph & Telephone Company, of Belle Plain, has been incorporated to operate a telephone line. Capital, $20,000. Incorporators, E. B. Goodwin, W. Goodwin, C. M. Goodwin, all of Millville; L. M. Hess, R. B. Hess, both of Belle Plain.

LATROBE, PA.—The Westmoreland Telephone Exchange will be connected with the tri-state system within the next 30 days. The line will connect at Greensburg with the Westmoreland Telephone Company. The tri-state system extends through Maryland, Virginia and western Pennsylvania.

LOUISVILLE, KY.—The formal absorption of the Ohio Valley Telephone Company by the Cumberland Telephone & Telegraph Company has been effected. The capital stock of the new company is to be $10,000,000. By the consolidation control is secured of the 10,000 miles of wire, with 40,000 subscribers and 11,000 toll stations.

NEW JERSEY LINEMEN.—The linemen and electrical workers on the extensive system of the New York & New Jersey Telephone Company have been on strike because of the company's refusal to employ members of the International Brotherhood of Electrical Linemen. Superintendent McCully says that the company is not at all inconvenienced.

WILMINGTON, DEL.—The Delmarvia Telephone Company, of this city, will extend its line to Perryville, Md. A line is being erected to Elsmere and from there will be extended to Newport, Newark, Elkton and Perryville. The company has also secured the right of way to Brandywine Summit, and will connect with the service from West Chester, Pa.

MINNEAPOLIS, MINN.—It is believed that the Mississippi Valley Telephone Company is negotiating with the Northwestern Telephone Exchange Company looking to a sale of the former's interests here. C. P. Wainman, general manager of the Northwestern, said, however, that the company had no idea of buying out the Mississippi Valley Company.

PITTSBURG, PA.—The Interstate Telephone & Telegraph Company, which was recently incorporated, has just published its plans of operation. The object of the new company, which is capitalized at $2,000,000, is to establish a long distance service in Pennsylvania, Delaware, Maryland and New Jersey by connecting all the independent telephone systems of these states.

ST. LOUIS, MO.—The Kinloch Telephone Company elected the following named officers, Jan. 30: Sam M. Kennard, president; William F. Nolker, first vice-president; William D. Orthwein, second vice-president; Breckenridge Jones, treasurer; Hopkins J. Hanford, general manager. The general manager's report showed that the company has 5000 telephones in use here.

CINCINNATI, OHIO.—Superintendent of Construction Robertson, of the Bell Telephone Company, under whose direction the entire local system is to be changed to the modern common battery system, expects to have the Freeman Street board in working order within the next eight weeks. There has been an increase of 300 subscribers since the first of the year in the Walnut Hills district.

LONG DISTANCE INDEPENDENT TELEPHONE SERVICE.—The long distance connection has been made of the Anderson (Ind.) Telephone Co., with the new telephone company lines at Indianapolis, thus placing Anderson in telephone communication by the independent lines with 6000 cities and towns of Indiana, Ohio and Michigan. The local company has been doing business for two weeks, and has 600 subscribers.

AN INNOVATION IN TELEPHONE SERVICE.—The telephone companies operating in Indianapolis have acceded to a novel demand by their patrons. If a subscriber wishes to be called at a certain hour for the purpose of taking a train, taking or giving medicine, or aroused for any other purpose, he leaves the schedule of calls with the chief operator, who looks after the calls. No complaints have been made, but many are the praises of the innovation.

PERU, S. A.—The French minister to Lima recently reported to his government that telephones in Peru are controlled either by private companies or directly by the state. There are six services, namely: Prura, 455 kilometers; Trujillo, 440 kilometers; Lima (public), 1658 kilometers; Lima (official), 48 kilometers; Chincha, 15 kilometers; Arequipa, 30 kilometers. The wires are overhead and the apparatus used includes the "Hunning," the "Blake," the "Bell," the "Ericsson" and the "Western Electric." Arequipa uses the German "Mix and Genest" apparatus.

BELL TELEPHONE.—The American Bell telephone instrument statement for the month ended Jan. 20 shows:

	1900.	1899.	Changes.	
Gross output	58,853	46,548	Inc.	12,305
Returned	18,966	14,719	Inc.	4,247
Net output	39,887	31,829	Inc.	8,058
Total outstanding	1,620,392	1,157,075	Inc.	463,317

MILWAUKEE, WIS.—The American Wireless Telegraph Company, with a capital of $1,000,000, was incorporated on Feb. 1 to make, sell and operate the instruments for wireless telegraphy invented by Warren S. Johnson and Chas. Fortier, who with Henry Herman are the incorporators. A factory will be built as soon as possible, and it will probably be here. The company will have an exhibition of its instruments at the Paris Exposition and thorough tests will be made there. Professor Johnson will exhibit his invention to the United States war and navy departments.

GOSHEN, IND.—At a meeting of the directors of the Goshen Telephone Company arrangements were completed to merge the local company with the independent lines of the county at a capitalization of $100,000; the valuation of the local company being taken at $30,000 and the Elkhart Company at $35,000. The combination takes in all the independent toll lines of the county and arranges for the purchase of a half interest of the independent toll lines from Goshen to Lagrange recently opened by the Lagrange Company. Hon. Charles W. Miller is made president of the new consolidated company.

ELECTRIC LIGHT AND POWER.

BELLAIRE, OHIO.—The electric plant of the National Steel Company was burned on Jan. 30; loss, $25,000.

KENOSHA, WIS.—The Kenosha Light & Power Company will be in the market for new apparatus in the spring.

WELLSBURG, W. VA.—T. J. Reid has been elected secretary and manager of the Wellsburg Electric Light Company.

ST. LOUIS, MO.—On Feb. 6 bids will be opened by the board of public improvements for the 10 years' lighting contracts.

DOVER, DEL.—A charter has been granted to the People's Light, Heat & Power Company, with an authorized capital of $2,000,000.

SAN JOSE, CAL.—The works of the Electric Improvement Company were destroyed by fire on Jan. 27. The loss is estimated at $100,000.

TAMPA, FLA.—The Tampa Electric Company has filed a mortgage for $300,000 in favor of the American Loan & Trust Company, of Boston.

LONG ISLAND SOUND.—One of the Sound steamboat companies ordered a Lundell generator to furnish 250 lights for one of its steamers.

YONKERS, N. Y., is reported by one of its residents to be suffering from an attack of the municipal plant fever and to be in need of remedies.

HAGERSTOWN, IND.—Municipal electric lights and water works have been decided on by the Hagerstown council, work to begin in the early spring.

READING, PA.—The Berks Electric Company is trying to secure the lighting contract in this city. If it succeeds in getting it, it will reduce the present prices.

MORGANTOWN, KY.—A number of citizens are considering forming a company with a view of establishing a daily launch line between this place and Bowling Green.

COLUMBUS, OHIO.—Emerson McMillin has resigned as president of the Columbus Light & Heating Company, and Samuel Thomas, of New York, was elected in his stead.

EASTON, PA.—The Easton Power Company has ordered $150,000 worth of electrical machinery from the Westinghouse Company. An 800-hp emergency steam plant will be added.

ST. PAUL, MINN.—The Manhattan Light, Heat & Power Company has been incorporated. Capital, $1,000,000. Incorporators, L. L. C. Brooks, A. W. Zahn, F. C. Nelson, all of St. Paul.

SIDELL, ILL.—The Sidell Electric Light & Cold Storage & Ice Company has been incorporated. Capital, $12,000. Incorporators, W. Bowen, J. H. Herron, A. W. Gray, all of Sidell.

GERMANY.—A cable despatch from Berlin, Germany, states that a 30,000-hp electrical plant is to be established at Lauffenburg, on the Rhine, the current to be used for industrial purposes.

PROVIDENCE, R. I.—The Bristol County Gas & Electric Company, recently absorbed by the Narragansett Electric Light Company, of Providence, is making large expenditures for improvements.

CAMDEN, N. J.—The Consolidated Electric Company has been incorporated to deal in gas and electricity. Capital, $100,000. Incorporators, S. R. Ketcham, C. H. Lamb, G. H. B. Martin, all of Camden.

MONTPELIER, VT.—The Consolidated Lighting Company, of this city, has completed its new transformer house. They transform the current generated at Bolton Falls for lighting and railway work.

ASBURY PARK, N. J.—The board of aldermen has directed City Attorney Hawkins to prepare a bill for the legislature, authorizing the city to increase its bonded indebtedness $30,000 for an electric lighting plant.

HOBOKEN, N. J.—The Municipal Light, Heat & Power Company, of this city, has been incorporated. Capital, $300,000. Incorporators, J. Bruning, of Hoboken; P. H. Wallenstein, J. H. Walsh, both of New York.

INDIANAPOLIS, IND.—The Washington Light & Water Company, of Washington, has been incorporated. Capital, $21,000. Incorporators, R. A. Brown, A. J. Padgett, H. M. Geiger, W. F. Burke, all of Washington.

JERSEY CITY, N. J.—The Puerto Principe, P. R., Electric Co. has been in-

corporated to manufacture electricity. Capital, $200,000. Incorporators, I. A. Kelsey, R. A. Betancourt, W. G. Bushnell, S. C. Moorehouse.

MILWAUKEE, WIS.—The James E. Patton Company have installed an electric light plant. A Milwaukee Electric Company's 30-kw dynamo supplies current to 150 incandescent and 10 arc lamps.

ROCHESTER, N. Y.—The Rochester & Suburban Railway Co. has been incorporated by F. Cook, G. W. Archer, W. C. Barry, J. N. Beckley, J. Gerling, all of Rochester. The capital of the new company is $420,000.

CHICAGO, ILL—Bids for a rolling bascule bridge of the Schenke pattern, to span the Chicago river at Canal and Sixteenth streets, have been advertised for. Electric power will be used in the operation of the bridge.

NASHVILLE, TENN.—The council is considering the advisability of establishing a municipal electric light plant in this city. The present contract with the Cumberland Electric Light & Power Company expires in May, 1903.

SAN MATEO, CAL.—The Belmont Light & Power Company, of this place, has been incorporated with a capital of $100,000. Incorporators, C. R. Spilvale, C. E. Dugan, W. A. Emmett, G. C. Ross, all of Belmont; N. T. Smith, of San Carlos.

NASHVILLE, TENN.—Mayor Head has recommended the city council to build an electric light plant so that the city can control the price of gas. A bill authorizing the sale of $150,000 bonds for this purpose has passed the first reading.

WASHINGTON, IND.—The Washington Electric Light & Power Company, of Washington, has filed articles with the secretary of state. Capital stock, $21,000. Directors, R. A. Brown, A. J. Padgett, H. M. Geiger and M. F. Burke.

EVANSVILLE, IND.—The projectors of the Evansville & Boonville electric line secured the right of way in Vanderburg County over a pike which cost $75,000, and proceedings have been instituted to rescind the action of the county commissioners.

PHILADELPHIA, PA.—An electric light plant is to be erected at Woodbury, N. J., by the Woodbury Electric Light Company. This will be devoted entirely to incandescent lighting and will be well equipped with power apparatus, machinery, etc.

THE UTICA ELECTRIC COMPANY was recently incorporated, with San Francisco as the principal place of business. Directors, J. V. Eichbaum, F. H. Eichbaum, M. J. Wright, H. Brooks and B. B. Rosekrans, all of San Francisco. Capital stock, $10,000.

SAN FRANCISCO, CAL.—Mr. Charles R. Lloyd, of San Francisco, who is interested in the Sacramento Electric Gas & Railway Company and the Mutual Electric Light Company, San Francisco, recently left for New York City and will remain in the east for a month.

BRIDGEPORT, PA.—The Bridgeport Electric Light, Heat & Power Company has been incorporated by J. S. Elliott, of Jefferson township; W. H. Fisher, E. T. Bradshear, both of Brownsville; G. D. Howell, W. J. Sturgis, both of Uniontown. Capital, $12,500.

RECEIVER ASKED FOR.—Mr. S. F. Van Choate has brought suit to restrain the Van Choate Electric Company and its officers from leasing or transferring any of its property as recently voted by the directors. The court is asked to appoint a receiver to preserve the assets.

JENNINGS, LA.—A contract has been made by the town of Jennings with R. S. Stearns, of the Westinghouse Electrical Manufacturing Company, of Pittsburg, for arc lights for the streets of Jennings for one year. A company will be formed to put in an electric light plant at once.

SACRAMENTO, CAL.—The San Pedro Company, of Los Angeles, has been incorporated. Capital, $100,000. Incorporators, F. H. Rindge, of Santa Monica; H. V. Carter, G. I. Cochran, W. Gilleden, L. A. Phillips, all of Los Angeles; W. J. Williams, W. W. Beckett, J. R. Haynes, all of Pasadena.

WEST BROWNSVILLE, PA.—The West Brownsville Electric Light, Heat & Power Company has been incorporated with a capital of $5000. Incorporators, J. S. Elliott, of Jefferson township; W. H. Fisher, E. T. Bradshear, both of Brownsville; W. J. Sturgis, G. D. Howell, both of Uniontown.

SAN LUIS POTOSI, MEX.—For the purpose of raising the money to furnish the city with electric light and power the authorities purpose levying a tax of 50 cents per month on all houses valued at $1000 to $1500; $1 on houses valued at $1500 to $5000, and on all houses over the latter sum $2 each.

TRENTON, N. J.—The Toms River & Island Heights Electric Light & Power Company, of Toms River, N. J., has been incorporated. Capital, $20,000. Incorporators, S. R. Applegate, C. A. Holmes, M. Buley, E. E. Snyder, A. Brant, C. Folkinburgh, G. H. Holman, J. Imlay, A. Ernst, A. Birdsall.

ST. LOUIS, MO.—Preparation of the plans for the plant of the Citizens' Electric Light & Power Company are in progress and the construction of the plant will soon begin. It has been definitely determined to locate the power house on the east side of the river, because of the saving in the cost of fuel.

BROWNSVILLE, PA.—The Brownsville Electric Light, Heat & Power Company, of Brownsville, has been incorporated with a capital of $12,500. The incorporators are J. S. Elliott, of Jefferson township; W. H. Fisher, E. T. Bradshear, both of Brownsville; G. D. Howell, W. T. Sturgis, both of Uniontown.

NIAGARA FALLS, N. Y.—The Niagara Falls Gas & Electric Company has petitioned the common council of this city to be allowed the right to connect a tunnel with the tunnel trunk sewer in order that the discharge of water through said sewer may be utilized for developing power. Hon. Frank A. Dudley is president of the company.

ST. LOUIS, MO.—A special meeting of the stockholders of the Imperial Electric Light, Heat & Power Company has been called for March 10 to vote upon a bond issue of $1,500,000 to be covered by a deed of trust on the property. Extensive improvements are necessary as part of the plan to furnish power for the United Railways Company.

NASHUA, N. H.—The Blodgett Estate Heat, Light & Power Company, with a capital of $30,000, has been incorporated here, but it will carry on business in Boston. The incorporators are Warrer K. Blodgett, of Cambridge, Mass.; Edward E. and William A. Blodgett, of Brookline; Stephen H. Blodgett, of Lawrence, and Charles J. Hamblett, of Nashua.

INDIANAPOLIS, IND.—D. M. Parry, who owns the franchise for an electric light and power service in Indianapolis, outside of the "mile-square," has asked the board of public works for permission to engage in domestic and commercial lighting. The franchise is one secured from the Jenney Electric Motor Company granted by the city in 1891. The permission will likely be granted and Mr. Parry will erect a large plant.

YOUNGSTOWN, OHIO.—The Youngstown Electric Light Company will increase the capacity of its plant. A large brick addition will be built and an order has been placed with the Westinghouse Electric & Manufacturing Company for a 400-kw two-phase, alternating current units, which will be direct connected to a new 500-hp compound engine. The new machinery will give the company a total capacity of about 1800-hp. The estimated cost of the improvement is about $25,000.

ROCKVILLE, IND.—The Rockville Electric Light & Power Company has recently made a new five-year contract with the city to furnish street lights at $60 per annum; at the expiration of which time the town may purchase the plant if it so elects. If not, the contract is to be extended two years at $55 per light. A new power house will be built and new machinery installed, and the price of lights reduced considerably. J. S. McFadden is president, and W. J. White, secretary.

BOSTON EDISON.—C. L. Edgar, vice-president of the Edison Electric Illuminating Company, of Boston, Mass., has been elevated to the presidency, succeeding the late Jacob C. Rogers. Director Walter C. Baylies is elected vice-president to succeed Mr. Edgar and C. W. Amory has been elected a director to fill the vacancy caused by the death of Mr. Rogers. The office of treasurer has been removed to Room 77, Devonshire Building, by reason of the dissolution of the firm of Jacob C. Rogers & Co.

A MUNICIPAL ELECTRIC LIGHT PLANT.—The city council of Richmond, Ind., has made a favorable report and submitted estimates of cost of construction and operation of an electric light plant to be owned by the city. The plant will be erected and ready for operation when the present contract with the Light, Heat & Power Company expires. Arc lights are now costing $90 each per year, and rates for commercial lighting are almost prohibitory. The council had over 30 letters from cities having municipal plants, all of which were favorable to municipal ownership.

BIRMINGHAM, ENGLAND, has taken over the electric light undertaking which was acquired last year. The management of the electrical department will be in the hands of a special committee of the city council. The demand for electric light during the past year has been largely augmented and there is a satisfactory prospect of the business being self-supporting. The purchase money, £420,009, is obtained from the Power Works Loan Commissioners, and was paid over in a single check during the past few days.

NIAGARA FALLS, N. Y.—It is announced that the park commissioners at Niagara Falls, Ont., have agreed upon a plan whereby a syndicate of New York, Buffalo and Toronto capitalists will construct a power plant on the Canadian side of the river. The new company proposes to divert the water of the Welland River to a point near the cataract, and by the double use of the flow they will be able to develop over 200,000-hp. It was necessary to obtain the consent of the Ontario commissioners of the Niagara Falls Park, and as this has been granted, it is now announced that the work will be commenced immediately.

ST. LOUIS, MO.—Bids on temporary lighting contracts for this city have been submitted. The Laclede Gas Light Company's figures were $5.50 per 1000 incandescent lamp hours, on a total of 4,726,890 lamp hours. For the same district (No. 1) the Missouri-Edison Electric Company bid on 1,380,612 lamp hours at $30 for each 1000 arc lamp hours. For district No. 2 the latter company bid on 1,541,560 arc lamp hours and 4,261,460 incandescent lamp hours at $30 per 1000 arc lamp hours and $5.75 per 1000 incandescent lamp hours. For public building lighting in district No. 1 the Laclede Company bid 12 cents per kilowatt hour on 256,975,000 watt hours. For public buildings in district No. 2 the Missouri-Edison Company bid on 1,151,281,250 watt hours at 13 cents per kw-hour.

THE ELECTRIC RAILWAY.

IOWA CITY, IOWA.—An electric railroad is projected westward from this place for about 25 miles.

NEW YORK, N. Y.—Third rails are being distributed along the Manhattan Elevated Railway Company's lines.

NEW HAVEN, IND.—This place no doubt would welcome an electric railway. There is an opportunity for one here.

POTTSVILLE, PA.—The Pottsville Union Traction Company will extend its lines to Middleport and Heckersville Valley.

ALBANY, N. Y.—The Staten Island Midland Railroad Company has certified to the secretary of state the various extensions of route.

GRAND RAPIDS, MICH.—Work on the Grand Rapids & Kalamazoo Electric Railway has been started. The line will be completed by July 4.

HAVANA, CUBA.—Superintendent Goudie, of the Havana & Guanabacoa Electric Railway, has secured permits to extend the road to Cojimar Beach.

CHICAGO, ILL.—The minority bondholders of the Lake Street Elevated road are preparing to apply for the appointment of a receiver for that property.

PORTLAND, ORE.—The City & Suburban Railway Company, Portland, Ore., will soon have an additional 500-hp unit ready for operation in its power house.

INDIANAPOLIS, IND.—The Indianapolis Street Railway Company has commenced the manufacture of summer cars. They will be built on a special design.

FREEPORT, L. I.—A franchise to build a trolley line through Freeport, L. I., was granted to the Nassau Belt Line Company by the village board of trustees.

THE BLANCHARD STREET RAILWAY, of Findlay, Ohio, a horse car line, has been sold to parties living at Saginaw, Mich., and will be equipped with electricity.

FLINT, MICH.—The promoters of the electric road from Orton and Oxford to Flint have asked the town of Ortonville for a bonus of $10,000. It will not be granted.

MASSENA, N. Y.—A certificate of increase of capital stock of the Massena Electric Street Railway Company from $100,000 to $125,000 was filed with the secretary of state.

UNIONTOWN, PA.—The Connellsville & Uniontown Electric Railway has been organized by Pittsburg capitalists, who have secured right of way between here and Fairchance.

COLUMBUS, OHIO.—The Richmond & Eaton Traction Company, of Eaton, has been incorporated by A. Emanuel, S. A. Price, H. O. Cox, J. Weil, H. B. Pruden. Capital, $12,000.

PHILADELPHIA, PA.—Judge Simonton has suspended the appointment of a receiver for the Middletown Electric Railway Company, pending the disposition of certain materials.

ST. MARY'S CITY, MD.—Francis V. King, of St. Mary's County, has filed articles of incorporation for an electric railway to run from Washington to Point Lookout, in that county.

INDIANAPOLIS, IND.—W. C. Sample, purchasing agent for the Union Traction Company, placed a contract for 13 motor cars at a cost of $2500 each with the St. Louis Car Company.

A UNION is being organized among the employees of the Union Traction Co. and other lines at Marion, Anderson and Muncie, Ind. General Manager Henry promises aid to bring it about.

JERSEY CITY, N. J.—The Puerto Principe Tramway Company has been incorporated. Capital, $200,000. Incorporators, I. A. Kelsey, R. A. Betancourt, W. G. Bushnell, S. C. Moorehouse.

HUNTINGTON, IND.—The board of county commissioners of Huntington County has granted to the Indiana & Ohio Traction Company a 99-year franchise for an electric line through the county.

INDIANA.—In order to meet competition of trolley lines, the Big Four will parallel its track from Anderson to Indianapolis, and on the second track will run commutation trains for local passenger business.

BATH, ME.—The Lewiston, Brunswick & Bath Electric Railway has practically abandoned the plan of building an extension from Brunswick to Portland, on account of the rise in the price of materials.

DAYTON, OHIO.—The Dayton & Troy Electric Railway Company has been organized with a capital of $30,000. Incorporators, J. M. Wilson, W. T. Caten, R. L. Worrell, L. C. Reynolds, T. B. Herrman.

GREENWOOD, IND.—The management of the Indianapolis & Greenwood line is gratified and surprised at the great traffic and business in packages offered. Some days it has been taxed beyond its facilities.

BALTIMORE, MD.—The Washington, Mechanicsville, Leonardtown & Point Lookout Electric Railway Company has been incorporated. The road runs through Charles, Prince George's and St. Mary's counties.

INDIANAPOLIS, IND.—Dr. R. C. Light, of Indianapolis, has been in New York, where he went to furnish a banking firm with the estimates of the cost of constructing the Indianapolis & Logansport electric line.

OTTUMWA, ILL.—The Fairfield & Ottumwa Railroad Company, of Burlington, has been incorporated. Capital, $1,000,000. Incorporators, H. B. Scott, T. W. Barhydt, W. Carson, W. W. Baldwin, C. M. Levey.

MONTEVIDEO, S. A.—The city council of Montevideo has determined to furnish electrical traction to the public, and it is expected that the work of converting the old lines will soon be begun.

WEST CHESTER, PA.—The Philadelphia & West Chester Traction Company has not abandoned the project of extending its line to Downingtown, but will build the extension in the near future and side-track West Chester.

NEW CASTLE, PA.—An opinion has been handed down in the case of Nicholas V. Leslie against the Mahoning Street Railway Company, in which the stockholders are ordered to pay off the indebtedness of the company.

CCLUMBUS, OHIO.—The Columbus, London & Springfield Railway Company has been incorporated by John G. Webb, John M. Good, Hart A. Fisher, Emmett Tompkins and Fletcher S. Penfield. The capital stock is $1,000,000.

HARTFORD, CONN.—The report that the Consolidated road was to erect a storage battery plant at Bristol, to be used in connection with the third-rail system, is officially denied. It has not been decided to erect such a plant.

BUFFALO, N. Y.—The officials of the International Traction Company have placed an order with the J. G. Brill Company, of Philadelphia, for 100 summer cars to be delivered this year. They will be equipped with double trucks.

DUNKIRK, N. Y.—The power house of the Dunkirk & Fredonia Street Railway Company was totally destroyed by fire a few days ago. All the cars were destroyed and traffic between the two places is suspended in consequence.

IRONTON, OHIO.—The Ironton Electric Light & Railway Company is to be sold if certain conditions of a financial character are not complied with. The decree is given in the suit against it by the Knickerbocker Trust Company, of New York.

COLUMBUS, OHIO.—The Columbus, London & Springfield Railway Company, of Springfield, has been incorporated here, with a capital of $1,000,000. Incorporators, J. G. Webb, J. M. Good, H. A. Fisher, E. Tompkins, F. S. Penfield.

INDIANAPOLIS, IND.—The power house of the Union Traction Company at Anderson will cost $83,000 and the machinery $675,000. The plant will supply power to all the street railway systems of Anderson, Muncie, Elwood and Alexandria.

PHILADELPHIA, PA.—The Union Traction Company is completing plans for the large car barn structure to be erected at Fifty-second Street and Lancaster Avenue. It will be brick and iron, with truss roof, having office and other facilities.

ELKHART, IND.—The Mishawaka-Elkhart-Goshen electric railway and all its appurtenances have been bonded for $1,000,000, for an extension to Michigan City and other points. The bonds were placed with the Girard Trust Company, of Philadelphia, Pa.

HUNTINGTON, IND.—An electric road is projected out from Portland piercing the oil fields and tapping Warren, Montpelier and Huntington. A bond issue to build and equip the road is said to have been arranged, work to begin in the spring.

A SUBSIDY TAX DEFEATED.—The election held in Lawrence township, Marion County, Ind., to vote on the question of a $35,000 subsidy tax for the benefit of the Fort Wayne & Indianapolis Railway, to use either steam or electricity, was voted down by a large majority.

WASHINGTON, D. C.—The Wesley Heights Railway Company has asked Congress for incorporation. The applicants for incorporation are M. C. Butler, John T. Arms, Thomas E. Waggeman, Dr. Henry D. Fry and John F. Waggeman, of the city of Washington, D. C.

DECATUR, ILL.—The Decatur Traction Company has issued $250,000 in 20-year 5 per cent. bonds and given a mortgage for that amount to the Union Trust Company, of Cincinnati, as trustee. It is the intention to expend $125,000 of this issue in improvements on the property.

PITTSBURG, PA.—The consolidation of the Monongahela, the East Pittsburg & Wilmerding and the Wilkinsburg & East Pittsburg electric street railways will be completed within a few days, with a capital of $3,500,000. All of these companies are dominated by the same interests.

PORTLAND, ME.—The Eastern & Southern Construction Company, of Portland, has been incorporated. Capital, $250,000. Incorporators, E. S. Hatch, of New York; C. B. Mead, of Louisville, Ky.; H. L. Cram, E. W. Hill, A. J. Desmond, N. N. Fuller, H. P. Sweetser, all of Portland.

RAILWAY EXTENSIONS.—The extension of the Cleveland & Chagrin Fall Electric Railway to Middlefield is nearing completion, and the company has decided to build another branch from South Newbury to Troy, Hiram and Garrettsville. A large power house will be built at Garrettsville.

DETROIT, MICH.—Bill of complaints have been filed in the United States circuit court by the Westinghouse Electric & Manufacturing Company, of Pittsburg, asking that a receiver be appointed for the Detroit, Lake Shore & Mt. Clemens Railway Company. A bill of $10,000 is due for motors furnished.

WORCESTER, MASS.—It is stated the Worcester & Webster and Webster & Dudley electric roads have been purchased by an out-of-town syndicate and that they will be consolidated. It is reported that the purchasers are the People's Tramway Company, of Putnam, Conn. The report of the sale is denied, however.

CHICAGO, ILL.—Suit was begun by the city of Chicago against the Chicago & South Side Rapid Transit Railroad Company for $20,000 damages for the alleged failure of the elevated railroad company to pay the $4000 annual trackage a lineal mile declared due the city in the ordinance under which the railroad was chartered.

INDIANAPOLIS, IND.—The Union Traction Company has awarded contracts for car houses and repair shops at Muncie, Marion and Anderson to Kiser & Williams, to Andrew Thomas and to John Schumacher, in the order named. Total estimate, $75,000. The contract for the central power house at Anderson, to cost $90,000, was to have been awarded on Feb. 1.

SANTIAGO, CHILI.—The *Deutsche Nachrichten* is authority for the statement that work upon the electric railways in the city of Santiago is now proceeding rapidly. The company is under contract to have 15 kilometres completed by the first of February, 1900, but there will be three times that much finished on that date. In seven years 700 kilometres must be in working order.

CHILLICOTHE, OHIO.—Mr. Isaac Cook, president of the Chillicothe, Mt. Sterling & Columbus Electric Railway Company, has applied to the commissioners of Franklin County for a franchise over the Jackson Pike. The company is very anxious to reach the central portion of Columbus with its cars, and has joined hands with the other interurban roads to secure entrance to the city.

AMSTERDAM, N. Y.—A corps of civil engineers has commenced making the preliminary survey for the proposed electric railway to connect Amsterdam with Saratoga and Ballston. The promoters are New York capitalists. The road will be operated from Amsterdam to Rockton, Hagaman and Galway, thence to Saratoga and Ballston. A. B. Paine, of New York, is at the head of the engineering corps.

WORCESTER, MASS.—Worcester men and capital are interested in the proposed People's Lake Line to run to the Shrewsbury side of the causeway, furnishing accommodation to Lake Quinsigamond and the oval. Incorporation with a capital of $75,000 will be asked for by the following named directors: John W. Knibbs, George A. Stevens, Maj. Harry B. Fairbanks, John J. Beaumont, Dr. Thomas J. Barrett, Samuel Brown and Joseph J. Vaudreuil. It is proposed to build a power house on the Worcester shore of the lake.

ATLANTA, GA.—Former Attorney General Frank S. Monnett and Judge M. L. Earnhart, of this city, are two of the incorporators of a company organized to construct and operate an electric railway from Atlanta, Ga., to Douglasville, Ga., a distance of 45 miles. The project is backed by a number of Ohio capitalists. The capital stock is $200,000 in $100 shares, all of which have been subscribed. At Austell, Ga., the water power known as Sweet Water Shoals is controlled by this company and will be utilized in supplying water for the power house to be erected there.

TRENTON, N. J.—The New England Electric Construction Company has brought suit against the Princeton & Trenton Traction Company. The construction company was employed to make survey, obtain a franchise and build a road for the traction company, and expended for these purposes $6268.12. The franchise was not obtained, and the traction company has abandoned its purpose, and intends withdrawing the $25,000 deposited with the state treasurer when the company was formed. The construction company wants the traction company declared insolvent, and the state treasurer restrained from returning the $25,000 deposited.

NEW YORK, N. Y.—At a meeting of the board of directors of the Brooklyn Rapid Transit Company on Feb. 1 the following named gentlemen were re-elected to fill the positions they now occupy: Chairman of the board, A. N. Brady; president, Clinton L. Rossiter; vice-president, H. C. Duval; secretary and treasurer, T. S. Williams; assistant secretary and treasurer, C. D. Meneely. Members of the Executive Committee, with the chairman of the board and the president members ex-officio: A. R. Flower, E. H. Harriman, Walter G. Oakman, H. H. Porter, Henry Seibert. Messrs. Harriman, Oakman and Porter represent the new interests that entered the board of directors at the annual meeting.

STATE REGULATION OF ELECTRIC RAILWAYS.—It has leaked out in Columbus, Ohio, that the representatives of the interurban electric roads, which have been in session there recently, have decided to draft a bill for the passage of a law for the governing of electric railways, similar to that in force in the state of Massachusetts. The bill will provide for the appointment by the governor of an electric railway commission to have charge of the electric railways now or hereafter to be constructed in Ohio. The jurisdiction of the commission is to extend not only over all lines outside the limits of the cities of Ohio, but also over lines passing into or through the cities. In other words, all the authority of city officials over interurban lines is to be taken from them and placed in the hands of the state commission. If this bill is passed it will settle the long drawn out dispute between the interurban roads radiating from Columbus and the city officials of that place.

THE AUTOMOBILE.

AUTOMOBILE ICE DELIVERY.—It is stated that the Hygienic Ice Co., just formed in New Haven, Conn., with a capital of $50,000, will deliver ice to its customers in automobiles.

AUTOMOBILE FENDERS.—The resolution introduced in the Chicago city council, providing that automobiles in the city be provided with fenders, has, it is reported, been buried in the Judiciary Committee's files.

THE PEORIA MOTOR VEHICLE COMPANY, of Peoria, Ill., is to be reorganized for the purpose of manufacturing automobiles. The capital will be $150,000, and, it is stated, the works will have a capacity of three vehicles per day.

MEXICO CITY.—The municipal council has approved a contract proposed by Mr. C. L. Seeger, for the establishment of a service of 100 electric automobile cabs. The service is to be in operation within two years. Mr. Seeger represents the Electric Vehicle Company, of New York.

THE AUTOMOBILE FORECARRIAGE COMPANY, of New York City, has been incorporated to manufacture and deal in carriages, automobiles, etc. Capital, $5,000,000. Incorporators, H. Bergholtz, of Ithaca; J. W. S. Langeman, of Paris, France; W. Hazelton, F. H. Rosse, both of New York City; E. J. Paterson, of Plainfield, N. J.

AUTOMOBILE RUN.—The first run of the Automobile Club of America, with headquarters in New York, took place a few days ago. Ten vehicles started from the Waldorf-Astoria for North Tarrytown. These included two electric carriages, one of which was a Riker dos-a-dos. Seven of the vehicles completed the run, a distance of 28 miles, the first carriage making it in 1 h. 45 min. After luncheon the return trip was made.

GENERAL CARRIAGE DISPUTE.—Thomas J. Montgomery, a stockholder in the General Carriage Company, has brought suit against that corporation, alleging that he is entitled to $1,000,000 of the carriage company's stock and $300,000 in money, which he says was promised to him on May 3 last, when he transferred to Joseph H. Hoadley, now the holder of $5,000,000 in the corporation's stock, rights for the territory within a radius of 25 miles from the city hall in the patent issued on July 26, 1898, for improvements in electric self-propelling vehicles, to Louis Krueger.

NEW COMPANIES.

PUEBLO, COLO.—The Oregon Land, Irrigation & Power Company, of Pueblo, has been incorporated, with a capital of $300,000. Incorporators, H. W. Gibbons, H. A. Case and G. F. West, all of Pueblo.

CAMDEN, N. J.—The Electro Chemical Light & Heat Company, of Camden, has been incorporated to manufacture electrical and chemical apparatus. Capital, $1,000,000. Incorporators, F. C. Dowd, J. L. Gethins, P. A. Dowd.

LOS ANGELES, CAL.—The Boyle Heights Electric Company, of Los Angeles, has been incorporated to conduct an electrical business. Capital, $100,000. Incorporators, W. B. Palmer, W. C. Pelchner, D. E. Skaggs, J. Adams, C. M. Buck, all of Los Angeles.

THE WESTERN ENGINEERING & CONSTRUCTION COMPANY, of New York City, has been incorporated to engage in a general construction and engineering business. Incorporators, T. H. Mene, George Cleaver and George Spencer, of New York. Capital, $100,000.

THE BUNNELL TELEGRAPHIC & ELECTRICAL COMPANY, of New York, has been incorporated to manufacture electrical supplies. Capital, $200,000. Incorporators, Mary T. Bunnell, DeW. C. Bunnell, both of Brooklyn; F. R. Green, of Fredonia; A. J. Wise, of New York City.

SAN FRANCISCO, CAL.—The Electro-Therapeutic Company, of San Francisco, has been incorporated to manufacture and sell electrical apparatus. Capital, $75,000. Incorporators: A. E. B. Ridley, G. L. Noble, F. W. Brann, S. Guggenheim, J. Luchman, J. O'Malley, all of San Francisco.

LEGAL.

REASONABLE DELAY.—The Western Union Telegraph Company has been successful recently in the Kentucky Court of Appeals in a case where the plaintiff sought to recover damages because his telegram was not delivered with sufficient promptitude. The despatch reached the receiving office at night. The business of the office was not large enough, in the opinion of the telegraph company, to warrant the employment of a night messenger; but the telegram was delivered the next morning at 6:40. The court, speaking through Chief Justice Hazelrigg, holds that the sender of the message had no cause of complaint against the telegraph company for the delay.

EDUCATIONAL.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—The annual catalogue of this institution for 1899-1900 is just out. It includes a list of the officers and students, together with a statement of the courses of instruction and a register of the alumni. It contains 357 pages.

UNIVERSITY OF PENNSYLVANIA.—The senior students of the mechanical and electrical engineering departments of the University of Pennsylvania spent Saturday last visiting the Midvale Steel Works. The primary object of the visit was to study the methods used in the open hearth process. The college department of the University of Pennsylvania has dropped 24 men from their classes for failure to pass the mid-year examinations, out of a total of 706 students.

PERSONAL.

A. EDW. NEWTON, treasurer of the Cutter Electrical & Manufacturing Company, sailed for Europe on Wednesday, Jan. 31.

MR. F. N. ARMOUR announces that he is no longer connected with the Siemens & Halske Electric Company, of America.

MR. C. C. WARREN, president of the Warren Electric Manufacturing Company, Sandusky, Ohio, has been visiting Chicago in the interests of his company.

MR. N. MONROE HOPKINS, of Washington, well known as an inventor, author and contributor to the technical press, has been appointed assistant in chemistry in the Columbian University, that city.

MR. JOHN E. WARD, of the Gold Street Car Heating Company, New York, has recently returned from an extensive business trip covering 12,000 miles and securing numerous orders for Gold electric heaters.

COL. MYRON T. HERRICK, of Cleveland, Ohio, so well known in electrical and street railway circles, is rumored to have been selected for the U. S. Treasury portfolio, to succeed Mr. Gage, if Mr. McKinley should be re-elected, Mr. Gage desiring to retire.

MR. W. M. SHEEHAN, of the firm of W. M. Sheehan & Co., was married at Newburg, N. Y., on Tuesday, Jan. 30, to Miss Clark, of that city. Upon their return from a honeymoon trip through the south the happy pair will take up their residence in New York City.

MR. FRANK E. MUSGRAVE, of Messrs. Musgrave & Son, engine builders, of Bolton, England, and Mr. Gregory, of the same corporation, are on a short visit to this country to investigate the construction and application of engines of large capacity to electric railway and lighting service.

MR. GANO S. DUNN, president of the New York Electrical Society and chief engineer of the Crocker-Wheeler Company, has been indisposed recently and was compelled to retire to Newburg, N. Y., for rest. His company had been doing a great deal of power work lately along new lines and in new fields.

MR. GRAHAM LITTLEBOY, manager of the English Electric Carbon Company, Ltd., of North Wales, is on a trip to this country with his brother-in-law, Mr. John H. Darby, a steel manufacturer. They are visiting various points of technical interest and will spend the best part of the month here.

MR. MARTIN MALONEY, the Philadelphia capitalist who is so prominent in electrical enterprises and has of late been building up a big independent telephone interest, has sailed this week with members of his family for Europe, in quest of health. He has been sick for several weeks, but expects much benefit from the ocean trip.

MR. THOMAS A. EDISON has been overworking lately—which seems hardly possible with a man of his steel constitution—and is now laid up at the home of Mr. Miller, his father-in-law, Akron, Ohio, with acute influenza, caught while attending his sister's funeral at Milan, Ohio. The latest reports are hopeful and remove the serious conditions that impended.

MR. C. L. BAUMANN, a Boer, born in Pretoria, who is in this country taking a course in electrical and mining engineering, is a young man of very decided opinions, and, according to the newspapers, he believes that the Boers are standing in the way of civilization. "While naturally my sympathies are with the Boers," he said, "I realize that victory for them will mean only additional obstacles to the country's development and enlightenment. Let the Boers win, and the country will be more than ever isolated. To-day foreigners have no voice in the conduct of the government; then they will be even more suppressed. Let the English triumph, and the country's natural resources will be developed. If they are defeated the Transvaal will be no place for foreign enterprise. Under such conditions, so far as the Transvaal is concerned, all my efforts at education would be lost." Mr. Baumann is a student in the Ohio State University.

OBITUARY.

MRS. ROSWELL SMITH.—The death occurred recently of Mrs. Roswell Smith, wife of the late president of the Century Magazine Company. As Miss Annie Ellsworth, friend of Professor Morse, she had the honor of sending the first telegraph message, "What hath God wrought!" from Washington to Baltimore.

MR. P. McD. COLLINS, a retired lawyer who died in New York City a few weeks ago, was the original concessionaire for the overland telegraph lines to Europe via Alaska and Siberia, abandoned in 1866, because of the success of the Atlantic cable. The Collins overland telegraph lines now bid fair to find their practical realization.

MR. GEORGE B. PAUL.—The death is announced of Mr. George B. Paul at Cuyahoga Falls, Ohio. He was the general civil engineer, etc., of the Northern Ohio Traction Company. He was 63 years of age, and at one time was in the United States navy. He is said to have designed the first steam canal boat that plied on the Ohio Canal.

Trade and Industrial Notes.

THE SIEMENS & HALSKE ELECTRIC COMPANY, of America, has moved its Boston office from 73 Broad Street to 72 Broad Street. Mr. E. T. Pardee is the district manager.

THE E. G. BERNARD COMPANY, Troy, N. Y., has recently shipped an electrical plant for the government station at Key West, Fla., to be used for lighting the fortifications and supplying current for firing the large coast defence guns at that point.

MESSRS. VALLEE BROS & CO., 625 Arch Street, Philadelphia, have just issued a folder on the Victor automatic time cut-out. The features of this apparatus to which special attention is directed, are compactness, simplicity, certainty, efficiency and cheapness.

THE CENTRAL ELECTRIC COMPANY, Chicago, is handling a large line of electrocarbons and Circular Loom products, and is in position to fill orders for these goods immediately on receipt. The company informs us that there is an increasing trade in all lines of electrical goods.

THE NEW ENGLAND ELECTRICAL COMPANY has been incorporated at Denver, Colo., with a capital stock of $50,000. The incorporators are L. P. Moore, George T. Yates and William Sayer, all of Denver. The company will manufacture and sell electrical machinery and supplies.

THE AMERICAN MINIATURE & DECORATIVE LAMP COMPANY, 125 White Street, New York, are distributing a very neat little souvenir in the shape of a scarfpin with an incandescent bulb unilluminated. This neat little article is gotten up very handsomely and nicely finished.

THE MONARC ENCLOSED ARC LAMP is fully described and illustrated in a catalogue issued by the Albert & J. M. Anderson Manufacturing Company, Boston, Mass. The catalogue shows that this lamp is made in six styles of finish, to suit the taste of the purchaser and surroundings.

THE ELECTRIC & MACHINE WORKS, of Los Angeles, Cal., was recently incorporated with a capital stock of $10,000, fully subscribed. The directors are J. H. Fountain, C. F. Fountain, Jessie Fountain, Thomas Foulkes, K. A. Foulkes, J. M. Foulkes and George L. Keefer, of Los Angeles.

MR. H. K. HOWRY, manager eastern sales department of the New York & Ohio Company, manufacturers of the Packard incandescent lamps and transformers, reports that both the domestic and export business of the company is the best in its history. This company has recently closed with the United States Commission to the Paris Exposition for the incandescent lamps to be used by the United States government at Paris.

GOULD & EBERHARDT, Newark, N. J., will exhibit at the Paris Exposition a 33 x 9-inch entirely automatic gear cutting machine, demonstrating the use of radial duplex gang cutters, finishing two or more teeth at one travel of the cutter slide. They will exhibit also a No. 1 water cutter grinding machine, and a 16-inch shaper showing extension base and "double triple quick stroke" systems. Each machine will be driven by an individual electric motor.

THE FALCON ELECTRIC MANUFACTURING COMPANY, 432 to 436 East Seventy-first Street, New York, are receiving exceptionally large orders for their fan motors, which are complete with all the latest improvements and various adjustments. This enterprising concern are also meeting with great success in their several other lines, namely, switches, switchboards, panel boards, power motors, attaching plugs and flush receptacles; and Mr. H. O. Showboda, the general manager, is exceedingly pleased with the outlook.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, will install the electric equipment of William H. Vanderbilt's summer residence on Long Island—"Idle Hour." An order received through the New York agency a few days ago calls for two 75-kw and two 30-kw engine type generators, direct connected, for this plant to be installed at once. A large number of teaser equipments are in course of construction for foreign houses, principally printing establishments. Arrangements are progressing for the much-needed extension of the plant.

THE NEW YORK AIR COMPRESSOR COMPANY, 120 Liberty Street, New York, has just issued a new catalogue of the New York air compressors, designed for all uses of compressed air power. It contains illustrations and descriptions of this company's standard sizes of air compressors, actuated by steam, gas or gasoline engines, belt power or water wheel, together with many hints of value to users of compressed air power. The useful information and tables which the catalogue embodies give it an especial value as a book of reference to all interested in the subject.

THE DAYTON GLOBE IRON WORKS COMPANY, Dayton, Ohio, has just issued a 116-page catalogue describing and illustrating the New American turbine, which is manufactured by this company. The construction of this turbine is fully explained, a clear understanding of which is greatly aided by means of illustrations of the parts. The catalogue contains a great deal of engineering information, data, etc., which will be found very useful by engineers in calculations. Several illustrations of applications of the wheel are also given, and, altogether, this is a most interesting and valuable publication of its kind.

MACHINE TOOLS FOR THE PARIS EXPOSITION.—At the invitation of the Springfield Machine Tool Company a large number of guests recently visited its new building at Springfield, Ohio, to inspect an exhibit of machine tools for the Paris Exposition, preparatory to shipment. Among the exhibits was a 32-foot shafting lathe with 24 inches swing, a 20-inch crank shaper, a Monarch lathe, 6 feet by 18 inches, and a Standard engine lathe, 8 feet by 18 inches. Machine tool men came from long distances to view the exhibit, which is one that will go far toward enhancing abroad the already great reputation enjoyed there by American machinery.

THE ERICSSON TELEPHONE COMPANY.—This company has issued the second of its series of publications in pamphlet form, containing telephone information of interest and value. The contents of the second part are worthy of careful perusal and preservation. In addition to pointing out the main advantages of Ericsson apparatus, there is an interesting brief history of the telephone in Sweden, where telephony has attained a high degree of development. The front cover of the pamphlet contains a diagram of connections of the Ericsson telephone, and on the back cover is a view of the telephone tower of the Stockholm exchange. This tower is a magnificent structure, and is said to be the largest in the world. The Ericsson Company issues parts of the series at regular intervals in convenient form for reference.

THE EDDY ELECTRIC MANUFACTURING COMPANY, Windsor, Conn., has just issued bulletin No. 16, pertaining to dynamos for the electrodeposition of metals. Some excellent illustrations of various styles of this class of machines are given, together with cuts showing some special features of construction. These machines are massive, and are particularly designed for the work for which they are intended. Bulletin No. 17, also just out, is devoted to electric motors for automobiles, as manufactured by this company. These motors are made in seven sizes, in capacity ratings ranging from 1.61-hp to 2.44-hp. They are very compact machines, and a concise description of their construction, together with illustrations of the machines, make very interesting information.

LUNDELL POWER MOTORS.—The Sprague Electric Company's trade literature is the admiration of all who see it, and catalogue No. 58, second edition, just issued, is an excellent example of high class literature of this character. It is a model of the printers' and engravers' art, and is devoted to a description of Lundell motors for power work. The features of the machine are described in very clear language, and the illustrations, of which there are many, show the variety of styles of motors produced by the company. The constituent parts of these well known motors are very clearly illustrated and with their aid an excellent understanding of the construction of the machine may be obtained. The catalogue contains 72 pages, 30 of which are devoted to illustrations of applications of the motor, and these show a great variety. Connection diagrams, motor efficiency curves and dimensional tables are also included in this excellent work, which reflects much credit on the company for its enterprise and taste.

A MODEL DRAFTING ROOM.—The new drafting department of the Schenectady Locomotive Works, Schenectady, N. Y., is regarded as a model of its kind, much care having been given to the attainment of the three essential conditions for the well being of those who are employed in this branch of the work. First, consideration has been given to the heating, lighting and ventilation of this apartment. A constant circulation of fresh air under all conditions of weather and temperature is obtained by means of the Sturtevant system of ventilation. The fan is direct connected to a General Electric motor and the fresh air, as it is drawn in, is heated by passing over the coils of a steam radiator. The air is admitted into the drafting room at points in the wall about 8 feet above the floor, while the vitiated air is withdrawn through openings at floor level. The room is lighted by General Electric enclosed arc lamps, the rays being thrown against the ceiling, whence they are reflected, thus giving a softer light throughout the room.

MONTAUK MULTIPHASE CABLE.—We are in receipt of an important letter from the Montauk Multiphase Cable Company, dated Feb. 1, in which they say: "We are glad to call your attention to the fact that on Jan. 22, 1900, an equitable working agreement was entered into, whereby an auxiliary company now being organized, secures the privilege of representing the Montauk Multiphase Cable Company as sole selling agent in a field covering one-twelfth of their territory. Under this arrangement, the parent company receives for the franchise and royalties granted, a satisfactory cash remuneration and becomes locally interested therein. The parties who have secured this valuable license for this initial territory are successful business men and recognized authority in electrical fields. The Montauk Multiphase Cable Company has several other negotiations of a like character in process of completion, and its business future as well as that of its licensees, under these conditions, presents a phase eminently satisfactory."

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that there never has been greater activity in electric lighting circles than at the present time, and that the demand for its now well known brand of "Monarch" incandescent lamps has become so large that it is having difficulty in supplying them. This lamp has been gradually improved to a point that the manufacturers are enabled to absolutely guarantee it as to life, efficiency and sustained candle-power. The company also states that the success of its new copper-case enclosed arc lamps has been instantaneous, and that though they have been on the market only a short time duplicate orders are daily received for them; while in all cases where there have been competitive tests these lamps have demonstrated their superiority as to general efficiency, accessibility to mechanism, regulation current consumption and volume of light. The company has gotten out several interesting and readable pamphlets describing and illustrating these lamps, which it mails on application.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JAN. 30, 1900.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Building, N. Y.]

642,081. PROCESS OF UNHAIRING ANIMAL HIDES OR SKINS; Geo. D. Burton, of Boston, Mass. App. filed March 5, 1898. During the time the hides are subjected to the action of an unhairing solution, a current of electricity is passed through the solution in lines parallel with the layers of hides or skins, the current being of sufficient volume to raise the hair and permit circulation through it.

642,102. ELECTRIC SIGNALING DEVICE FOR CROSSINGS; O. Fuchs, Dresden, Germany. App. filed Nov. 1, 1898. A square casing is suspended at the centre of the crossing on four cords in such manner that its four sides face the rails going toward the crossing point. A car coming along either set of rails will automatically cause a signal to be set on the corresponding side of the casing.

642,123. DYNAMO ELECTRIC MACHINE; E. W. G. C. Hoffmann, Charlottenburg, Germany. App. filed July 21, 1899.

642,164. ALTERNATING CURRENT WATTMETER; K. O. F. Schrottke, Berlin, Germany. App. filed April 22, 1899 (See Current News and Notes.)

642,169. GROUNDING SHOE FOR ELECTRIC WIRES; T. H. Stokes. Lincoln, Ill. App. filed June 12, 1899. The shoe has a pointed end and a socket for the insertion of a rod by which it may be forced into the ground. A suitable passage is formed transversely through the shoe, to carry the end of the wire to be grounded.

642,216. UNIT MULTIPLE SYSTEM OF CONTROL FOR ELECTRIC RAILWAYS; F. C. Esmond, New York, N. Y. App. filed Sept. 27, 1898.

642,252. AUTOMATIC ELECTRIC HEAT AND FIRE ALARM SYSTEM; R. P. and J. D. Osgood, Methuen, Mass. App. filed Sept. 29, 1899. In this invention all portions of the outer and inner circuits are kept constantly under test, so that no special test is required, such test being provided by a very small constant current which is flowing at all times. Under normal conditions the strength of this test current is too small to operate the alarms.

642,257. EMERGENCY THROTTLE VALVE; J. R. Reynolds, Hartford, Conn. App. filed July 26, 1898. Specific details whereby a magnet and its armature are used to cut off steam in case of an emergency.

642,274. MAGNETIC BRAKE; Thorsten von Zweigbergk, of Cleveland, Ohio. App. filed April 29, 1899. The brake consists of an annular braking member surrounding an axle, and with one face opposite a friction rubbing plate. On one face of the braking member are four polar projections, and the winding is laid around these in such a manner as to cause adjacent poles to assume opposite polarities.

642,537.—Method of Applying Lining Material to Conduits, Pipes, Etc.

642,362. SIGNAL; M. Pfatischer, Philadelphia, Pa. App. filed Oct. 30, 1899. In this system means are provided, consisting of lamps at each station, whereby the receipt of a signal at one end may be acknowledged by lighting the lamp at the other end.

642,363. TROLLEY POLE; F. Pfent and L. A. Moran, Greiner, Mich. App. filed May 1, 1899. The mounting at the base of the pole is such that the pole can yield laterally as well as longitudinally and in case of the wheel leaving the wire the pole will be held in a lowered position.

642,364. ELECTRIC MOTOR; E. S. Pillsbury, St. Louis, Mo. App. filed Aug. 28, 1899. The field core is provided with polar projections and main coils, including a plurality of the polar projections, the coils being so arranged that lines of force are most intense at the centre of each pole; also phase or starting coils which include a plurality of the projections of each pole, whereby when said coils are energized the phase or starting coils cause the centre of magnetism to be laterally displaced to produce an asymmetric field.

642,379. ELECTRIC SIGNALING APPARATUS; H. W. Souder, Lemaqua, Pa. App. filed Aug. 28, 1899. The track sections are each provided with two electrically operated signals near each end thereof and means whereby the passage of a car on to or off any particular section of track will shift signals of the section and illuminate the signals at the adjacent end of the neighboring track sections.

642,390. PROCESS OF MAKING SULPHURIC ACID; Frank P. Van Denbergh, of Buffalo, N. Y. App. filed June 15, 1899. Sulphate of calcium and a suitable flux such as sand are melted together in an atmosphere containing an excess of oxygen. This bath is subject to intense heat and also to electrolysis which latter produces sulphur oxides, which take up oxygen and become SO_3. This latter is then hydrated to produce sulphuric acid.

642,408. SANITARY ATTACHMENT FOR TELEPHONING APPLIANCES; Arthur J. Wolff, of Hartford, Conn. App. filed June 7, 1899. A removable paper cone fits into a holder adopted to be applied to a transmitter mouthpiece.

642,414. MANUFACTURE OF ELECTRICAL RESISTANCES; J. F. Bachmann and Adolf Vogt, Vienna, Austria-Hungary. App. filed Oct. 8, 1897. (See Current News and Notes.)

642,424. MAXIMUM INDICATOR; C. R. Brown, Dedham, Mass. App. filed Aug. 7, 1899. (See Current News and Notes.)

642,515. ARMORED CONDUIT; J. B. Boutillier, Boston, Mass. App. filed Nov. 1, 1899. The conduit has a lining composed of a helically wound strip of sheet asbestos expanded against the internal surface of the pipe.

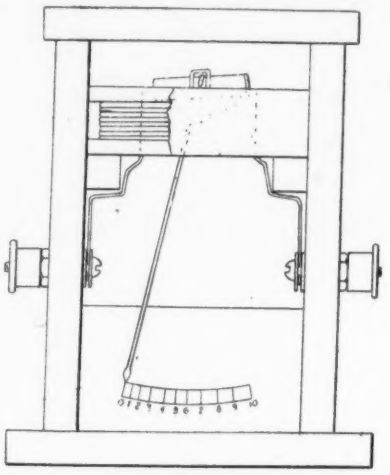
642,521. JUNCTION BOX FOR ELECTRICAL CONDUCTORS; E. T. Greenfield, New York, N. Y. App. filed Dec. 18, 1899. A junction box composed of two parts, one of which is provided with openings and the other with corresponding disks adapted to close said openings when the two parts of the box are put together. Openings that may be required for the entrance of conduits are uncovered by breaking away the discs.

642,537. METHOD OF APPLYING LINING MATERIAL TO CONDUITS, PIPES OR THE LIKE; A. Thoma, Cambridge, Mass. App. filed Nov. 30, 1898. The method consists in directing into the lining, after it is in place within the pipe, a blast to act progressively on the lining at successive points throughout its length and force it into intimate contact with the inner walls of the pipe at every point throughout the area of the adjacent surfaces.

642,538. ARMORED INSULATING CONDUIT; A. Thoma, Cambridge, Mass. App. filed July 29, 1899. A heavy iron pipe is provided with a lining of an extensible, highly flexible, composition of matter in intimate contact with the walls of the tube.

642,539. METHOD OF LINING CONDUITS, PIPES OR THE LIKE; A. Thoma, Cambridge, Mass. App. filed Aug. 24, 1899. The method consists in introducing the lining material upon a supporting-ply within the conduit and then removing the supporting-ply.

642,551. MECHANISM FOR DRIVING DYNAMOS FOR ELECTRIC LIGHT ON RAILWAY CARS; P. Kennedy, New York, N. Y. App. filed July 8, 1899. The invention consists in the use of a grooved pulley on the axle, a similar pulley on the dynamo shaft, and a third idler pulley in connection with a belt having a cross section corresponding to the shape of the cross section of the grooves in the pulleys.



642,563.—Electrical Measuring Instrument.

642,553. RAIL BOND; C. J. Mayer, Philadelphia, Pa. App. filed Dec. 1, 1899. Since the lower flange of the rail has upper and lower faces inclined to each other, the terminal stud of the bond is provided with a projection adapted to pass into an opening in the flange, the said projection rising from a base having two faces respectively parallel to the faces of the flange. The object is to insure close contact between the stud and the flange when the stud is riveted therein.

642,554. RAIL BOND; C. J. Mayer, Philadelphia, Pa. App. filed Dec. 1, 1899. An improvement upon the preceding, adapted for girder rails.

642,563. ELECTRICAL MEASURING INSTRUMENT; F. M. Bennett, New York, N. Y. App. filed April 29, 1898. An excitable metallic body carrying an index finger is set above a coil and mounted in bearings which are eccentrically placed so that one end of the body will move into and out of the coil.

GERMAN PATENTS, ISSUED JAN. 17, 1900.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

106,153. TELEPHONE CALL; Fr. Welles, Berlin. App. filed March 27, 1897. Each subscriber's station is provided with two relays controlling the local circuit for the annunciator. These relays are connected with the two wires of the shunt and the ground in such a way as to send a certain current-combination into the system by means of a suitable key. This current-combination acts upon the relay of the station to be called up, so that only on this station the local circuit will be closed and the annunciator drop.

106,679. MULTIPHASE SYSTEM OF DISTRIBUTION; Charles Felton Scott, Pittsburg. App. filed Sept. 20, 1898. In order to change a three-wire single-phase system into a four-wire two-phase system, the middle wire of the first system is connected to one of the outer wires of a second three-wire system carrying alternating currents shifted 90° in relation to the first; a fourth wire leads to the other outer wire of the second system.

106,762. ELECTRODE FOR STORAGE BATTERIES; Alexander Pallavicini, Berlin. App. filed Feb. 17, 1899. The carrier for the active material consists of a perforated lead-plate with bent edges and having on both sides a number of pins. The electrode can be cast in one single piece and the edges bent over, after the active material is put on, whereby soldering is made unnecessary.